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Engineering News-Record

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Unloading Sacks of Sand to Top a Threatened Levee on the Mississippi

Fighting the Mississippi Flood Above Vicksburg

By W. W. Deberard,
Western Editor, Engineering News-Record

A report of a four-day trip made along the river during the highest water on record. Illustrated with a special insert plate of views.

Other Articles:

Load Tests of Piers for Chicago's New Union Station
An Analysis of Connecticut's Traffic Census; *J. G. McKay*
Alumina Cement; Its Development and Manufacture; *H. S. Spackman*

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN *Editor*

Volume 88 — NEW YORK, MAY 18, 1922 — Number 20

Railway Tunnel as Public Work

THE action of a special session of the Colorado legislature in passing by a large majority a bill authorizing the creation of an improvement district to provide funds for a mountain railway tunnel indicates acceptance of the principle that under certain conditions a railway may be regarded as a public improvement. An older case in the same class was the construction by the city of Cincinnati of the 340-mile Cincinnati Southern Ry., shortly after the Civil War, in order to open up a trade route between the north and the south. In that case the money was raised by city bonds. Plans to build the Moffat tunnel by means of bonds issued by the State of Colorado or the city of Denver were not successful, but a project to build it by the bonds of an improvement district has now been authorized by the legislature. It is not probable that this system will be applicable in many cases but its development in connection with the six-mile Rocky Mountain tunnel will be watched with interest.

Building Dynamiting in Chicago

CHICAGOANS could hardly have been surprised at the dynamiting last week of a building under construction and the subsequent efforts to connect the crime to the band of crooks who control the Chicago building labor situation. The control by criminals has been well known and has been freely exploited in the controversies growing out of the work of the Citizen's Committee to Enforce the Landis Award. In fact it is generally recognized in Chicago that this criminal control is the chief bar against peace there in the building industry. For years the city has been "held up" by its building labor. Honest citizens resented the tactics but did not become aroused to firm action until labor refused to live up to its contract of accepting the arbitrator's (Judge Landis') award. The dynamiting outrage should serve to band all honest men, in labor ranks as well as among the general citizenry, for a fight to a finish to clear Chicago of this criminal influence. Reports from Chicago indicate that this is what is happening.

Safe Hydraulic Fill Dam Construction

THE studies of core formation at the hydraulic fill dams of the Miami Conservancy District, as they are summarized by Chief Engineer Charles H. Paul elsewhere in this issue do much to dispel the fear of hazards in construction which has been created by failures of dams of this type. Briefly the conclusions of the construction engineer from the experience at Miami are that the safe construction of hydraulic fill dams is quite possible, with a variety of glacial drift, and consists in holding the balance level between a speed of raising embankment which is safe and a speed of moving earth, fast enough to keep the costs low. This is a task of construction experience and judgment and the rules and procedure vary for every filling operation. Apparently the occurrences which the constructor has most to guard against in hydraulic fill dam building is to prevent variation of the position of the core in the embankment and the incursion into the core of coarse material by shore slips and subsidences. Bringing the fill up in low lifts, particularly when the embankment is built up by sluicing on one side at a time, and using an excess of core material and wasting the finest so that the core fill will stiffen up more rapidly, are correctives to both these hazards. Their employment, as stated, is determined by construction experience and judgment.

Rapid Transit or Politics?

UNFORTUNATELY, a long delay will probably intervene between the announcement of plans for New York rapid transit and the operation of trains. This is due not only to the need for time to study, legalize, and prepare, but also to the situation that has made of the New York transit problem a political football. We are not concerned with New York politics. We are, however, profoundly concerned with the efforts of engineering science and constructive energy to serve effectively the foremost American city in what is probably its most harassing physical problem. Engineers are available to plan and direct; thousands of workmen are ready to man the mills, shops, and quarries that will supply the materials; contractors with specially designed plant and skilled organizations are ready to take hold of the job; and mechanics and laborers of every sort are seeking employment. There is need for the work and there is need for the job, for the inadequate transit facilities of New York constitute a public scandal. In the face of these conditions, unnecessary delay, obstruction, or political manipulation would be little short of a calamity to the citizens of New York.

Fire Prevention and the Business Man

DOWN at Atlantic City last week a group of men as sincere and enthusiastic as any in the country discussed the question why fire prevention efforts have not been more successful. The question itself constitutes a remarkable admission of failure, failure in a necessary and worthy effort. Of course the fact of the matter is that there has been progress in fire-prevention ideas: The present-day attitude toward fire dangers and fire prevention is much more enlightened than that of two or three decades ago. But the change is hardly more than what would naturally result from general increase of enlightenment on matters of public concern. Real interest in fire prevention as a measure of public protection and economy is very slight indeed. Quite properly the fire-protection specialists desire more rapid progress in their campaign of betterment, which is of necessity in the main a campaign of public education; the tremendous importance of the daily fire waste sufficiently justifies this desire. Hence the question which

was discussed by the National Fire Protection Association. There is a simple answer for it, we believe. It is that the fire-prevention men have never managed to present their case in truly convincing manner, or presented it to the right people. Everyone's experience will tell him that the big, impressive message of fire prevention has never been "put across" to the ordinary citizen, or, let us say, to the business man. Otherwise we would surely see the most directly interested class, the building owners and insurance-policy holders, making the campaign their own and working ceaselessly for reduction of the general fire danger.

Shingles and Radio

A GREAT deal of well meaning fire-prevention propaganda has been like the boy's cry of "Wolf" in the fable. After the first time or two it scared no one. The average citizen in the course of his daily ups and downs becomes more or less hard boiled, and is not very receptive to arguments that are rejected by his sound practical sense. This psychology is probably responsible for the ineffectiveness of the underwriters' persistent campaign against the wood shingle, a campaign whose weakness lay in absurdly overshooting the mark. The aim was to induce home builders to use incombustible roofing; the method was to endeavor to alarm the whole community over the imminent danger of destruction residing in its shingle roofs. Unfortunately, every citizen is fairly well familiar with the long satisfactory service of such roofs, and his common sense therefore not only keeps him from becoming alarmed as he was meant to be but also leads him to discount the real fire-prevention message. A less pronounced but newer example of the wolf cry appears in the current week's news. The Bureau of Standards has sent out a warning bulletin addressed to everyone—that is, to every owner of a radio receiving set—that he should equip himself at once with elaborate protection against the lightning danger residing in his aerial and lead-in wiring. The bulletin refers to a new radio-protection rule drafted by a committee of the National Fire Protection Association, which, by the way, is moderate, sane and practical in the highest degree. But the warning is couched in alarmist terms, vaguely but effectively suggesting that radio equipment is dangerous. No proof is given that antennas increase the lightning danger of a house, nor is even a plausible case established. The common citizen, whose home is already joined up with miles of electric light and telephone circuits capable of collecting atmospheric super-potentials along their whole length, and whose metal roof gutters and back yard trees afford excellent means for "attracting" lightning, will not become much excited over this warning bulletin. On the contrary, he will lose a little of the faith—such as he may have—in the dependability of public scientific organizations, and he will be less ready to believe future statements about lightning or fire danger, and to accept warnings issued from similar sources.

The Water War

STRIKINGLY like the world war in many aspects is the water war which is now being waged on the lower Mississippi to retain that stream within the levee system. The same precipitate action has been taken in expanding organization, in utilizing human power instead of machines for the task at hand, and in the making of quick decisions amounting to educated guesses. As in war, too, the whole expense is lost once the danger is past. Men were recruited in a few hours time not days. They had to be cared for and fed. A skeleton form of directing force grew into a workable unit over night. To provide subsistence for large forces at uninhabited points behind the levees is no small task. The work is most primitive, mostly handling sand or earth in sacks on the backs of men, for the laborers are many, the skill is little and most machines not sufficiently mobile to be of use. Decisions as to where to work and what to do when a soft back slope or a sand boil is discovered do not await an engineers' calculations or a layout by a transit. "Do it now" is the slogan, for a few hours delay too often means defeat. The really discouraging thing is the fact that temporary flood protection work is anything but satisfactory; it is costly and only by superhuman effort and the highest grade of morale is it effective.

Morale, A Factor

MORALE is noted as a factor in flood fighting because practically all of those in charge use this one word perhaps more often than any other. The activation of men to carry out orders, to get work done and material moved under unknown conditions is an asset without which failure would surely result; spirit, the engineers' officers like to call it. Leaders must be picked with the magnetic ability to transmit the spirit of fight and action based on good judgment. Organizations of all kinds must be harmonized and their efforts brought to bear on the situation in an effective way. Labor must be recruited continually. Relief, if it is not to be dissipated among loafers, must be co-ordinated with the labor recruiting. Money has some times been spent in topping levees, the most showy part of the flood fighters effort, simply to make people and the workers "feel" safer and better. River equipment is moved about from place to place for the same reason. "It it worth $500 to keep up the spirit of these people" was the significant remark of one of the engineers in ordering a quarterboat from one locality to another. So morale, meaning the belief that the river really can be held back, is no small part in the fight. In fact without it the fight were long ago lost, in the opinion of the leaders.

Mississippi Flood Facts Needed

JUST now the fight to hold the levees is the spectacular and dramatic feature of the Mississippi flood. Later there will come the reconsideration of the problem of controlling the river which is the regular sequel to every record flood. During normal water no one but those engineers concerned does any thinking or talking about the Mississippi, but as soon as the floods reach first-page notice new theories grow apace and old ones are revived and the proponents of the levee system are forced publicly to defend that method of control. After the 1912 floods the then president of the Mississippi River commission, Col. C. McD. Townsend, quite adequately filled the role of defender and his various papers in 1912 and 1913 (see *Engineering News*, Oct. 31, 1912) stand as masterly expositions of the hydraulics of the Mississippi. His disposition of reservoirs, reforestation, parallel channels, outlets and cutoffs leaves no doubt as to the inadequacy of the only suggested competitors of the levee, which, by elimina-

tion at least, justifies the adopted method of control.

Nevertheless when this year's waters go down there will be need for the broadcasting of some fundamental facts. So far as has been reported there was no record rainfall over the whole drainage area of the Mississippi, or at least the rainfall coincidences were by no means such as to produce the maximum river flow below the Arkansas. And yet we have had the highest water ever recorded in the Mississippi. This raises several questions which the river authorities will doubtless answer soon: What was the discharge this year; how near to the Commission's ultimate high-water estimate did this year's gages read; what was the relation between high water and the tops of the so-called completed levees? In other words, is it a fact, as some opponents of the levees are claiming, that a combination of rainfalls by no means as severe as may be possible has produced in the river a series of stages beyond previous predictions and rendered necessary a revision upward of the levee standards heretofore established as the ultimate to be required?

For around $50,000,000 it is claimed that the Commission's project can be completed and the river held, by strenuous methods in flood times, to be sure, but held at a not unreasonable cost. Experience this year in the work of defense upholds this view, but the extremely high water is ominous and needs some explaining. Have we reached the high-water stages which may be expected or are the levee-top ultimate elevations to be raised once more and probably again? These are questions which must await the full record of the flood and the statements of the Commission as to the relation between flood heights and levee standards as built.

A Plan for the New York District

NOTHING in the two or three decades of the present era of city planning in America equals in importance the news given out last week that work is well under way on a Plan for New York and Its Environs. There has been a growing realization of the fact that any plan for a city that is a great center is incomplete if it stops at its own boundary line. In the New York metropolitan district recognition of the importance of regional planning was shown several years ago when a conference on the subject was held. That conference gave promise of others designed to take up unified and co-ordinated planning for greater New York and allied or outlying territory to the east, the north and the west, in the states of New York, Connecticut and New Jersey. Apparently this project came to an end almost as soon as it was begun, very likely because of its magnitude, both physically, politically and financially, but more than all through lack of any one agency which in itself or as a nucleus for co-operation could offer that solidity and continuity that is a prime essential of even a city planning scheme for a single large municipality.

It may well be noted that, with the exception of our national capital, Chicago affords the most notable instance of city planning and city planning execution in the United States, and the achievements there have been due primarily to private effort. Rightor, in his notable exposition of the Chicago city planning work under the very misleading title, "What of the City," makes a strong plea for the endowment of city planning wherever it is to be undertaken. This or its equivalent is now being afforded by the Russell Sage Foundation, created for human betterment and directed by the deed of trust to expend some portion of its income for the special benefit of New York City and vicinity. If endowment of planning for a single city is considered necessary by one who has lived and worked through years of successful effort at Chicago, how much more necessary is it for the making of a suitable plan for New York and its environs, a task which will necessarily extend through many years and which, if ever one could expect that it would be taken up another way by the very large number of cities, big and little, towns and villages and wholly rural districts, would be subject to all the many mischances of inter-municipal jealousies and of the political changes in various municipalities which, under our American system, seem to make it mandatory for one political administration to discount and even undo what has been begun by another?

It is more than fortunate, therefore, that a plan for New York and its environs has already been put well under way by so stable an organization as that which has been created for this special purpose by the Russell Sage Foundation, as announced in detail in our news section this week. Confidence in the success of this notable attempt in American regional planning is all the greater because of the men who have thus far been associated with the work and are to continue as it grows in scope and detail.

Undoubtedly it will appear as time goes on that as great as may be the physical and financial problems which will have to be met, greater and more troublesome still will be those of a political nature, due to the location of the area involved in three different states. But this should only add interest to the work of unification by regional planning. In fact, taking a broad and far reaching view of the geographical field of regional planning, it is difficult to see how a unified governmental administration can be expected in this particular instance, at least, short of carving out a new state from portions of three old ones. In the future this may come. For the present co-operation and consolidation of governmental areas located in three states and scattered in hundreds of communities must be sought. Such co-operation has been achieved with notable success in some parts of the country, mostly within a single state and for what may be termed elements of a city plan, such as water supply or sewerage, or parks, rather than with city planning as a whole.

For the present the main thing to be considered, so far as the plan for New York and its environs are concerned, is that work is actually well under way on a magnificent regional plan. Such a plan once provided, it will at the very least afford an ideal toward which many of the diverse elements in regional planning may be shaped even if not everything is achieved. The need of the moment and of the next few years is for an embodied vision; the ideals of the seers—corrected by the common judgment, as Elihu Root happily phrased it at the conference when the plan was announced—reduced to the form of a plan or series of plans; the whole made plain, convincing and stimulating to the imagination by the combined work of the topographical engineer, the aerial photographer, the city planner and the brush of the artist as was done in the case of the Washington and Chicago plans, and as may be done on the far larger and grander and more varied scale for the larger area and the more diversified topography by water and land in the case of New York and its environs.

Fighting Floods on the Mississippi Above Vicksburg

Construction Methods of Handling Levee Maintenance During the Highest Flood of Record—Organization Details Down to the Plantation Laborers and How They Function Under Emergency Calls

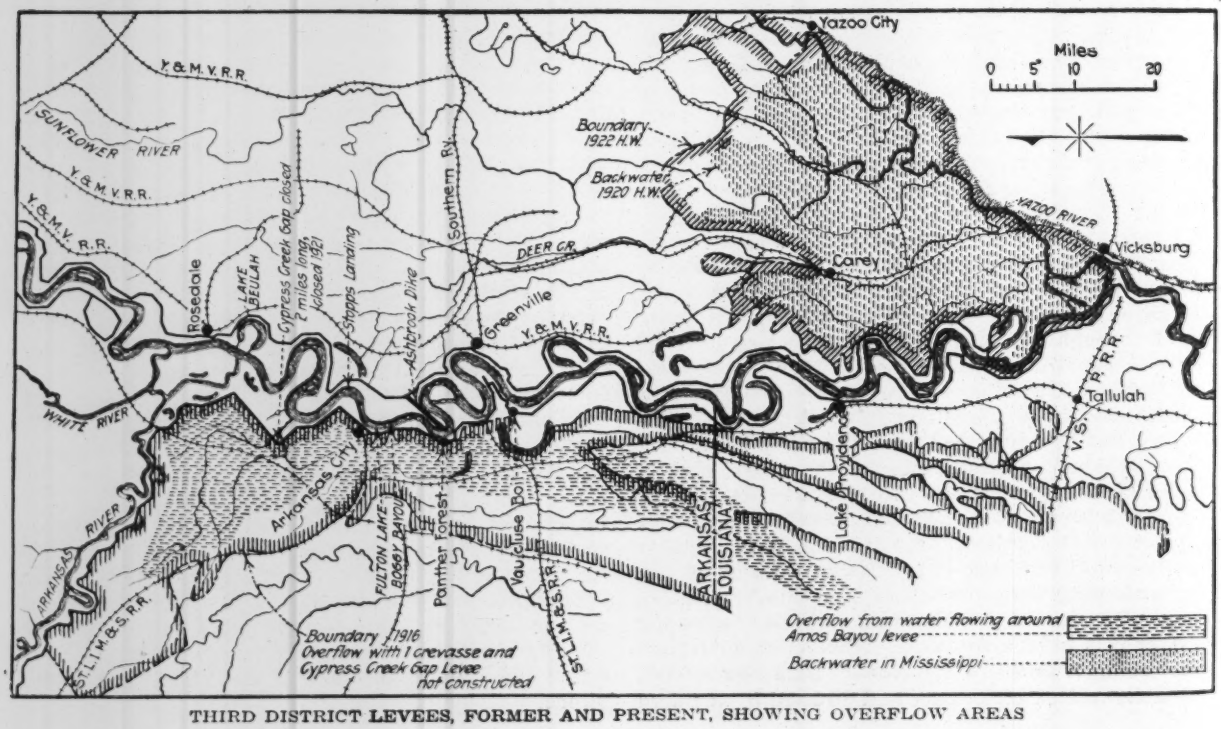
By W. W. DeBerard
Western Editor, *Engineering News-Record*

(With Insert Plate of Views)

THE highest flood of record persisting for the longest time yet recorded has been passing down the Mississippi River testing the strongest and highest levees, some of them to destruction. Crevasses have occurred at three points in Louisiana but as yet the upper stretches above Vicksburg where breaks would devastate the greatest areas have held; held by seemingly superhuman effort, vigilance, and pre-planning against tremendous odds because the floods have come in the midst of raising the levees to Mississippi River Commission standard grade and section. Many narrow escapes from failure have occurred. This article proposes a portrayal of some of the dramatic victories won by the flood fighters above Vicksburg, mainly directed by the engineers of the commission. The battles lost at the crevasses are heralded wide in the newspapers because of the devastation, money damage and physical deprivation, although less actual suffering occurs and less relief is required than is supposed. Inhabitants having always experienced flood water know how to live "upstairs."

FILLING TRENCH SACKS

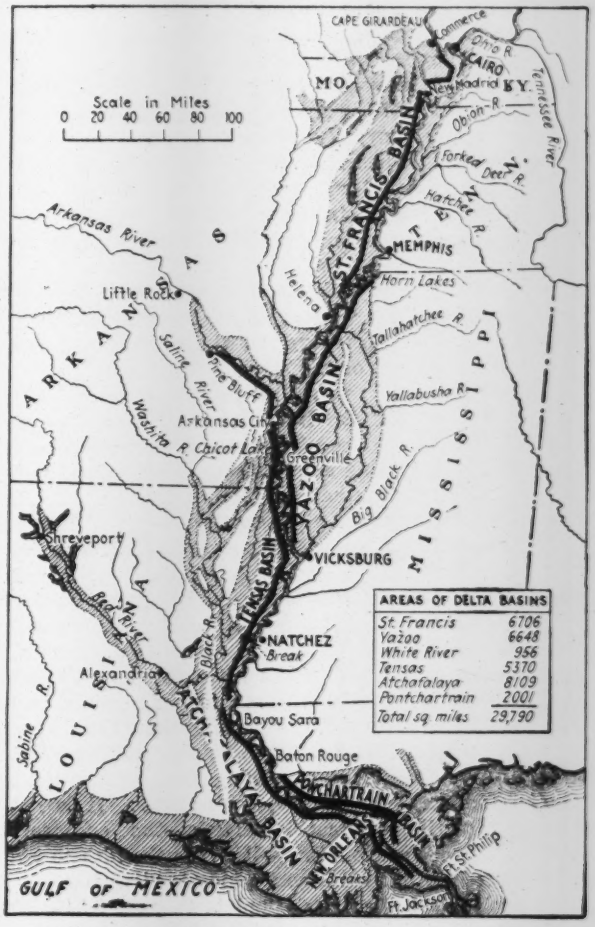
The control of the Mississippi by levees was fully described by J. A. Ockerson, of the Mississippi River Commission, at the recent Dayton meeting of the American Society of Civil Engineers in a paper abstracted in *Engineering News-Record*, April 27, 1922, p. 703. The problem, however, is so large on 2,000 miles of levees and the factors so numerous that few engineers outside of those directly in contact with it sense the outstanding features. The crux of the situation is the holding of the low and weak levees in the 200-mile stretch above Vicksburg. The stra-



THIRD DISTRICT LEVEES, FORMER AND PRESENT, SHOWING OVERFLOW AREAS

tegic points are the levees on both banks, in Arkansas centering on Arkansas City and in Mississippi the stretch between Rosedale and Greenville. Closing a 2-mile gap at the mouth of Cypress Creek in the west-bank levee 20 miles above Arkansas City last season eliminated an enormous backwater reservoir and outlet for 200,000 sec.-ft. available in all previous rises above flood stage. In consequence the streets of Arkansas City are dusty during a flood perhaps for the first time in its far-famed history. The added water held in by the new levee on top of the highest-of-record stages at other points shoved the Arkansas City stage 1.6 ft. above any previous flood. Engineers estimated that the closing of the gap might raise the normal crest at Arkansas City anywhere from 0 to 2 ft. and the embankments on both sides were being increased in height in this sector 5 ft. to meet the standard section and grade of the commission.

The work of levee raising near Arkansas City has proceeded just as fast as the limited funds of the commission and levee board would permit. To encounter a highest-of-record flood in the midst of any construction of hydraulic work seems the fate of the engineer. Perhaps it is as well. It teaches him humility and nature shows while he is on the job her worst side. The highest-of-record and the closed-gap factors occurring together threw down a gage of battle which only the most modern of flood fighters utilizing every scientific weapon at his command would seriously attempt to engage. There were available good roads for land transport of men and equipment, water transport including steamers, barges and gas launches for quick movement of material and men, the telephone to make organization easily mobile and organization, headed in a skeleton way by the U. S. Army engineers, whose every call for men and supplies was instantly answered by the local levee boards who were able personally to reach down through the highly interested planter to his field hands.



MAP OF THE LOWER MISSISSIPPI SHOWING PRESENT LEVEE SITUATION

DATA ON PRESENT AND PREVIOUS HIGH WATER STOPS OF MISSISSIPPI—MAXIMUM GAGE READINGS ON MISSISSIPPI RIVER AND TRIBUTARIES FOR HIGHEST FLOOD YEARS SINCE 1884

(Compiled by A. Miller Todd, U. S. Ass't. Eng'r.)

Stations	Miles From Cairo	Elev. of "O" C.D.	Flood Stage	1884	1886	1887	1890	1891	1893	1897	1898	1899	1903	1906	1907	1909	1912	1913	1920	Up to May 5 1922
Cincinnati	504	449.4	50	71.1	55.8	56.3	56.8	57.3	50.6	61.1	61.1	51.5	53.2	50.2	65.1	54.3	51.7	69.8	54.6	52.1
Ohio River				19	12	6	7	9	1	8	10	3	6	1	10	4	3	13	10	
Nashville	244	334.8	40	45.6	49.3	44.3	50.7	29.0	20.0	48.8	24.0	37.6	40.6	34.3	28.2	39.8	46.6	44.9	44.1	45.1
Cumberland R.				13	14	7	11	0	0	15	0	0	2	0	0	0	14	9	14	
Chattanooga	495	651.9	33	36.8	52.2	27.3	42.5	29.0	30.0	37.9	18.0	40.0	31.0	13.7	8.0	25.0	30.2	33.1	43.6	34.8
Tennessee River				4	11	0	5	0	0	6	0	8	0	0	0	0	0	1	5	
St. Louis	191	400.2	30	15.7	23.7	20.1	5.4	11.8	31.6	16.9	22.8	19.9	25.2	24.4	26.3	35.2	30.8	27.2	28.0	33.9
Upper Miss. R.				0	0	0	0	0	5	0	0	0	0	0	0	11	9	0	0	
Cairo	0	290.8	45	51.8	51.0	48.5	48.8	46.2	49.3	51.7	49.8	46.2	50.6	46.9	50.3	47.3	54.0	54.7	51.4	53.6
Miss. R. (below Cairo)				24	21	42	38	13	18	49	17	26	19	12	15	21	45	27	43	
New Madrid	70	275.7	34	41.5	40.4	37.7	38.2	36.4	38.1	40.2	38.3	36.1	39.6	37.0	39.3	38.6	44.0	44.6	40.2	
				25	24	38	43	55	29	54	21	34	42	18	19		57	30		
Memphis	230	203.7	33	34.2	34.8	35.3	35.6	34.9	35.2	37.6	37.2	35.2	40.1	37.1	40.3	38.6	45.0	46.5	40.3	42.3
				23	19	39	46	55	26	53	20	34	43	19	30	39	61	34	48	
Helena	307	162.0	42	47.0	48.1	46.3	47.7	44.7	47.9	51.8	49.1	46.8	51.0	47.0	50.4	47.6	54.3	55.2	50.1	52.3
				75	27	40	55	59	51	60	24	49	51	21	33	26	60	35	57	
Sunflower Ldg.	357	147.1	39	....	....	....	42.9	40.9	43.0	47.2	46.0	44.3	48.0	45.2	47.7	45.2	50.8	51.3	48.2	
							105	69	58	69	29	45	78	25	37		77			
Little Rock	176	241.5	22	12.8	12.8	6.5	17.8	17.7	17.0	17.6	9.8	6.4	19.6	8.5	10.4	25.1	14.6	6.9	13.3	23.2
Arkansas River				30.6	17.9	17.6	23.9	20.7	27.2	22.9	29.3	25.9	26.2	21.8	20.4	6	23.9	19.0	22.1	
Clarendon	134	158.9	25	....	28.5	27.8	34.6	28.2	29.3	31.0	30.5	24.2	32.6	28.7	28.5	28.9	32.6	30.4	29.5	30.8
White River					29.2	27.9	36.6	29.1	33.9	32.4	35.4	29.6	60	33.1	32.3	44	86	39	29.6	
Mouth White River	393	128.7	42	47.9	48.2	47.8	50.4	47.7	49.5	52.4	51.0	48.5	53.7	49.8	51.9	50.0	56.3	55.4	53.1	56.9
				103	52	47	117	80	63	77	37	57	84	36	45	76	89	43	98	
Arkansas City	438	116.4	42	46.5	46.9	46.7	49.5	48.2	50.2	51.9	51.2	49.6	52.9	50.0	52.1	50.1	55.3	55.2	54.0	58.0
				99	47	42	112	74	61	71	35	52	81	28	46	83	85	42	88	
Greenville	47.8	108.0	36	41.1	41.2	40.8	43.4	43.2	44.3	46.7	46.2	43.0	49.1	44.9	47.3	44.8	50.8	50.4	47.0	52.0
				108	54	49	111	77	61	74	35	54	81	33	43	78	84	41	51	
Lake Providence	542	89.6	36	38.4	37.9	38.0	41.0	41.0	41.8	44.5	44.4	41.7	46.5	43.7	46.3	44.4	48.3	48.0	45.5	49.6
				92	25	32	106	73	58	75	35	51	79	34	45	90	83		84	
Yazoo City	65	93.3	25	....	22.1	23.8	26.6	28.3	25.6	31.5	24.4	25.8	27.9	22.6	26.1	25.9	30.3	29.8	31.0	31.9
Yazoo River					0	0	92	75	18	0	0	26	42	0	17	29	75	45	149	
Vicksburg	599	66.0	45	49.0	44.2	44.7	48.0	48.1	48.3	52.5	49.4	47.3	51.8	47.2	49.7	48.0	51.7	52.2	50.9	55.0
				79	0	0	96	64	45	70	27	32	64	20	34	27	62	38	64	
Natchez	700	36.8	46	47.4	53.8	44.2	46.9	46.5	46.8	49.8	47.4	46.2	50.4	46.7	48.9	47.7	51.4	52.6	51.5	55.5
				20	0	0	66	51	43	62	14	9	54	12	24		59	38	69	
Shreveport	320	160.9	29	....	....	....	18.4	34.4	25.2	24.0	24.1	13.0	15.6	33.1	12.3	16.5	10.2	19.3	12.3	26.2	31.0
Red River							0	32	0	0	0	0	0	34	0	0		0	0	0	
New Orleans	957	20.9	16	15.5	13.8	14.5	16.0	16.0	17.4	19.0	15.9	16.0	19.4	16.0	18.7	17.9	21.1	19.3	19.2	22.6
Carrollton Gage	...	.....	..	0	0	0	9	1	25	9	0	1	74	2	39	22	64	43	69	....

So the problem above Vicksburg in its natural and man-made aspects appeared after several days contact with the "commissioned officers, non-coms and buck privates" in this war with water. It is a three-sided affair. If one side of the river loses the other side wins, for the common enemy, the river, can only ruin one side. While no one would be so base to suggest cutting a levee armed guards patrol 1-mile beats and have definite instructions to bring in those without business on the levee as well as to report on new leaks, seepages, boils or incipient slides.

Chicago was left on an hour's notice at the invitation of Col. C. L. Potter, president of the Mississippi River Commission, with Vicksburg as the destination and Major J. A. O'Connor of the U. S. Engineers in charge of the Third Division, as the first point of contact. "Go up the river and see the battle on the ground—and water. Talk with the flood fighters and then come back to Vicksburg" were his suggestions. "This office will get the statistics together in the meanwhile. C. B. Allen, engineer in charge at Rosedale, a veteran fighter for 30 years will pass you over the river to E. S. Maupin, assistant engineer in charge at Arkansas City, loaned from Monroe, La., to relieve W. L. Lipscomb, junior engineer, worn out and in the hospital. Mr. Maupin will get you down to the Vaucluse boil where C. J. Lawson, Greenville, is in charge." This article was written at Arkansas City under a 30-ft. levee, topped, drained and matted and after several days following these river men, tramping levees with the water nearly at its crest lapping the sandbag topping, making launch expeditions to boils, slides and mattressed back slopes. It is not intended to write a scientific article—the engineers reports are renowned for that—but it is the idea to tell of the work from the average engineer's viewpoint.

The problem of the Mississippi is to pass 2,250,000 sec. ft. of water draining two thirds of the United States down the tube of a funnel varying from 1 to 10 miles wide, with the adopted method of control—the delimiting of the flood channel by means of levees—only partly completed. Velocities of 11 ft. per second in 105 ft. of water indicate the horse power available. Reservoirs exist at the delta entrances of a few rivers but are of little use; 1,000 sq. miles at the mouth of the White and Arkansas and 1,500 sq. miles at the mouth of the Yazoo River. The methods of handling the work and the organization are somewhat complicated but the construction of mats for slides, of placing filled sacks for topping and around boils are comparatively simple; management, finance, human interest and politics a-plenty and intricate detailed engineering a miimum. Not a surveyor's instrument was visible. What need for levels when every layman had a high-water-mark stake to supplement those driven every mile by the engineers of the commission.

Incipient breaks and dangerous conditions have developed in many places, some of the most important of which are as follows: On the Mississippi side seeping back slopes and boils developed at Stopps Landing. On the Arkansas side north of Arkansas City boils and overtopped levees appeared near Chicot Landing. Soft back slopes and a slide occurred on the city river front. Boils showed at camp C-2 and a most serious slide occurred at Fulton Lake. The last was the closest to a failure in the 60-mile line. A large boil in the levee toe at Vaucluse was considered almost as serious and required five days attention with 1,000 men.

PACKING AND LOADING SACKS FOR RINGING BOILS

Maintenance of the Mississippi River levees during floods calls for central direction and practically a military though flexible organization down to the last laborer carrying sacks. The central skeleton organization heads up at St. Louis under Colonel Potter, president of the Mississippi River Commission, reporting to Maj. Gen. Lansing H. Beach, Chief of Engineers, U. S. Army. Each of the four districts is in charge of a district engineer. Major J. A. O'Connor, district engineer for the Third District in which one of the most serious situations was located has A. M. Todd as principal assistant engineer in general charge under the district engineer. In the field E. S. Maupin with headquarters at Arkansas City handles 60 miles of the west bank levees from Red Fork to and including Leland Dike, Ark. Continuing on the west side, J. R. Adams with headquarters at Lake Providence, La., has a 40-mile section from the Arkansas state line to Point Lookout, La. In Mississippi C. B. Allen with Rosedale as headquarters has a 65-mile section extending from the Coahoma-Bolivar County line to the Washington County line. Remaining portions of the levees in the Third District are in the hands of the local levee boards. The levee boards furnished the local labor. The commission furnishes the regular river equipment of steamers, barges, quarterboats, snag boats and launches. Supplies consist mainly of subsistence except sacks, of which 5 million are being used. Many trench sacks from war department stores have been made available.

At Arkansas City, which is an example of an extended organization, seven department heads report to the engineer in charge; construction, subsistence, office force, transport, advisory board, guards and a labor department.

The construction head has seven engineers or overseers; each is assigned to about 10 miles of levees and has from two to seven foremen working with the foreman accompanying the planter's quota of laborers. Five quarterboats and crews under a foreman are used for districts not within easy reach. Each has full responsibility for work and subsistence of his men.

The subsistence department head for 1,600 men has a purchasing clerk who distributes supplies from a main store to each of three camps and five quarterboats. A chief steward has stewards at a foreman's kitchen improvised on a depot platform and at each of the two 700-men camps located where work was formerly under way by levee drag-line operations. A group of 250 convicts are fed from one of the camps. Night and morning meals are served in camp but for lunch it is the stew-

ards duty to locate the men and transport meals to them on the job by launch.

The office work under a chief clerk consists mainly of pay rolls and is handled by a pay-roll inspector and seven clerks. Often it is necessary to pay off gangs every day on account of changing personnel. All records relating to bills, material and labor are kept in accordance with government precedure.

The transport department utilizes the railroads for materials, supplies and men from a distance. It has 9 launches, 3 steamers and 1 tug for towing and transporting men, 14 motor trucks for hauling in men but mainly for bringing to the levee sacks filled with "buckshot" clay. This haulage was over an asphalt state highway from a pit 1 mile away to a barge loading point in town within reach of a clam-shell bucket. The paved connection with the 153 miles of hard road recently completed greatly facilitated the movement of men from the various plantations. A special train of 21 cars having unlimited right of way brought 3 million sacks

TRUCK LOADING POINT ON RIVER STREET, ARKANSAS CITY

Trucks dump sacks, men load to a clamshell which dumps on the barge. River at this point is 30 or 40 ft. above the main street of Arkansas City, shown here.

from Schenectady, N. Y. in 90 hours, said to be record-breaking time for movement of freight.

The advisory board consisted of two old flood fighters, one in charge upstream and the other downstream both interested financially and politically in seeing that nothing was neglected to safeguard the levees.

Guards, 120 in number, patrolled the levee night and day. The levees were divided in ten sections of variable length. Two men watched two bad spots continuously. It was required that every section be walked top and toe at least once each shift looking for soft spots, cracks, insipient slides and boils.

The labor department has one man in charge from Louisiana and one from Arkansas. Labor is recruited through special local boards and the number of men requisitioned is prorated according to population. It is the business of the two labor heads to furnish transportation for the men and to look after them in personal ways while on the job. The laborers, mostly farm hands, are replaced weekly so as to inconvenience the planters as little as possible.

Labor at Stopps Landing under Mr. Allen was recruited in a marvelously quick time. An inspection at 2 p.m. indicated that trouble was imminent from boils and soft back slopes. At 4:30 p.m. a phone requisition to the Rosedale headquarters was put in for 1,500 men. The phone was used by the officials of the local levee board and by 8 p.m. that same night in a driving rain 400 men were on the ground. By 8 a.m. next day 1,200 more arrived in motor trucks with plantation foreman. Within a few days the force was raised to 6,000. The men came from a radius of 75 miles, 30 and 40 on a truck. The Delta Land and Planting Co., an English syndicate, owning 30,000 acres and working 3,000 people, formed the nucleus of the force. How Mr. Allen and K. C. Young, who happened to be in charge at this particular point of an inactive drag-line came, housed and fed these men besides getting results on the levees may be likened to the first few days of cantonment construction.

CONSTRUCTION

Levee maintenance during highwater periods is a primitive task carried on with sacks and brush put in place rapidly by hand. Only small tools are used, such as shovels and occasionally tampers and carrying barrows for heavy sacks. The divisions of the work are as follows: Stopping slides, reducing the flow of boils, topping the crown, erecting bulkheads for resistance of wave wash, draining the back slopes, and matting the back slopes with sacks and brush.

Slides are probably the most serious features to handle although boils in or near the toe of the levee may prove equally serious. Speed in reporting is highly essential with slides, as a large gang and plenty of materials are needed at once. Slides usually occur on thin, pervious, saturated land-slide enlargements of levees and the movement is fact. The most serious occurrence in the Arkansas section was the Fulton slide opposite borrow pits from which a land-side enlargement had been made. This slide developed about 10:30 p.m. April 16 and was discovered less than 30 minutes after it started by a guard who reported it to headquarters 2 miles away. A crack 180 ft. long, 2 ft. back from the water line appeared and was soon followed by a 1-foot drop. Despite the driving rain, within 2½ hours 300 men with barges filled with sacks and willows, kept on hand for such contingencies, were at work. A quarter-boat fitted with extra bunks carrying 400 men was available for emergencies, but this slide was so near Arkansas City 230 convicts quartered in a garage in the center of the town were rushed to the site. They filled 1,100 cu.yd. of sand into sacks the first night. The river was rising and was within 0.2 ft. of its crest level. The drop of material at the top of the slide eventually was 9 ft. and left only a 2-ft. thickness of earth to keep out the river. A Delco demonstrator lighting system mounted on a Ford truck was loaded onto a barge for light.

Repairs were made in the following order: (1) A willow mat was thrown over the portion immediately at the break and lightly loaded with sacks to prevent as much crumbling as possible. (2) A 6-ft. bulkhead was set up at the toe of the slide and sacks piled up 6 to 7 ft. deep over willows on the flattened toe of the sliding portion. The bulkhead was not relied upon as much as the weight of the sacks. (3) Willows, weighted lightly so as not to increase the tendency to slide were placed over the whole surface to maintain as much crust stability near the surface as possible. Additional weight was added where bulges appeared. The force was 450 men days and 400 men nights for 5 days during which time at least 500,000 sacks were placed on a levee length of about 200 ft. Failure would have resulted in a crevasse that would have inundated the west side down to the Red River. (4) A timber bulkhead 12 ft. from the center line of the levee and 8 ft. wide, filled with sand, was constructed to throw the center of gravity of

he remaining portion of the levee toward the river side. Sand was also spread along the water side of the levee as a blanket to reduce seepage to a minimum. Experienced river men considered this slide the most dangerous ever controlled.

Boils are indicative of a sandy foundation and lead to blow-outs due to carrying away material from the foundation. Undermined, the levee subsides if enough material is withdrawn or if becomes sufficiently saturated. Boils are most dangerous therefore when they occur at or near the toe. Beyond 200 ft. they rarely cause concern although they are not neglected if they carry silt and especially if they carry material which it is suspected may be coming from below the levees.

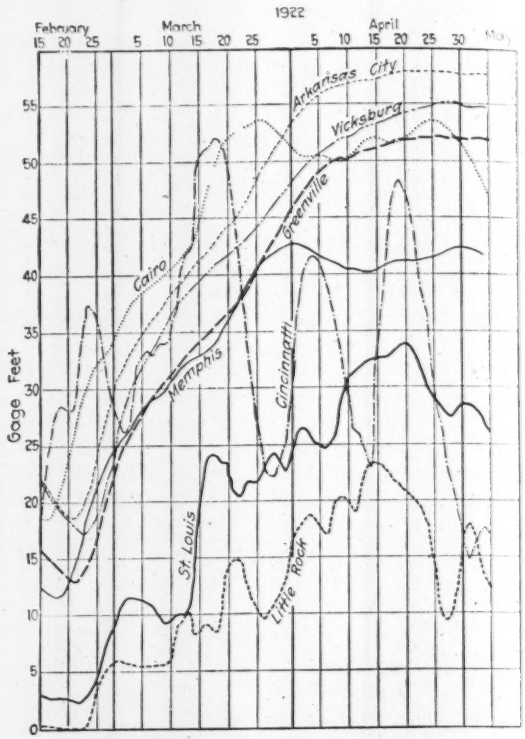
The method of repair is to raise evenly a water blanket over the boil just to the point where efficient filtration will begin and silt carrying cease. A greater height than necessary greatly increases the danger of a break outside the ring, loop, or sublevee of the enclosing embankment. Small boils are ringed with sacks filled with clay. Larger ones may have a sub-levee permanently thrown up around them from a previous flood as at Stopps Landing on the Mississippi side where many acres have been enclosed by sub-levees of various heights. Occasionally it is expedient to step down the head a second time and even a third time by concentric embankments. Usually the embankments are looped back to the levee if the boil occurs near the toe. A miniature crevasse was found at a high spot in one of the 20-acre sub-levees of bags at Stopps Landing, but was discovered before it unblanketed the whole area. Material was obtained for filling the sacks in the fields nearby.

A series of small boils occurred near Rosedale extending back about 1,000 ft. from the levee. As is usually the case the affected area is an old loop of the river and a long sub-levee will be the only feasible method of blanketing it. As the blue silt washed up was believed by Mr. Allen to be coming from about 60 ft. below the ground surface no trouble was apprehended so long as the flow did not materially increase.

Forty boils occurred 1 mile down stream from Arkansas City at Camp C-2 in an old landside borrow pit made when the levee was the 6-ft. railroad embankment. Now the levee is 25 ft. high and the original removal of the 4 ft. of clay cover over the quicksand in the pit permits an easy communication with the river. Under the present construction all borrow pits are on the river side and all old land-side pits giving trouble from boils will be filled as the levee is brought up to standard section. The material for the Camp C-2 boils was brought over the levee from barges by sliding the sacks in chutes to the toe and also from material sacked in the field.

The most serious boil was at Vaucluse, opposite Greenville where the crater occurred near the toe of the 40-ft. levee crossing an old river bed. It was 3½ ft. across and a sack ring 20 ft. in diameter was brought up 8 ft. high before checking it. Before finally coming under control, three concentric loops had to be built, stepping down the pressure three times. The levee settled about 3 in. for a distance of about 250 ft.

Topping where the bank is protected from wave action by nearby timber growth consists simply of dropping clay-filled sacks in place and locking them together by tamping and tramping. The best bag is a 100-lb. sugar



GAGE HEIGHTS OF 1922 FLOOD ON THE MISSISSIPPI RIVER

sack filled half full only. Trench sacks are too light and are easily flipped out of place by the waves. Where necessary to use part sand-filled sacks they should not be placed on the water side but as backing behind at least one row of clay-filled sacks. The sand washes out rapidly and permits the water to pass.

Timber bulkheads backed by sacks are used to minimize wave action. In front of Arkansas City the river is several miles wide and the wind has been known to throw logs into the street damaging the crown. A heavy 2-in. plank bulkhead has been placed for the entire length of the river street. It is braced every 6 ft. with 2 x 8-in. planks back to a railroad track on the banquette.

Near Stopps Landing about 3 miles of topping and matt on the back slope has been placed. For about 1,200 feet the levee was from 4 to 8 in. below the crest elevation. Probably 30 miles of the Arkansas section is topped but not so continuously at any one place. It is estimated that 40 miles of levees above Vicksburg has been topped; 10 miles in Mississippi and 30 miles in Arkansas and Louisiana.

Wave-wash protection by sacks behind a bulkhead may be necessary on newly completed full section levees as at Rosedale. Bermuda grass takes about 2 years to produce a matt that is immune to waves. Plans for completed levees at the more exposed points call for a 4-in. concrete slab pavement.

Back-slope matts and drainage are important since upon them is reliance placed to maintain the integrity of the surface crust and to weight it down. Drains down the slope are cut from 2 to 6 ft. apart to carry off seepage and rain water. Willows are placed up and down the slope, care being taken not to shut off the ditches. Sacks of sand are then piled on top of the willows. K. R. Young, superintendent at Stopps Land-

ing, cut the hoe-blades of his drainage maintenance crew into a V-shape to facilitate cleaning out the drains. Well-drained and particularly well-matted slopes are not likely to develop "puffs" which raise the surface grassed crust. These puffs indicate that the action and reaction are nearly equal. They usually contain clear water and the area should be drained and weighted with sacks. Many of these puffs developed in the levee slopes near Stopp Landing and were so handled. Blanketing with clay on the water face is one method of eliminating them as well as direct leaks.

Closing Cypress Gap—Closing the 2-mile gap in the river at the mouth of Cypress Creek in 1920 and 1921 is responsible in a measure for the 1.6-ft. additional rise at Arkansas City over previous crests. The maximum section occurs for about a mile and is 55 ft. high, has an 8-ft. crown and 425 ft. base. The elimination of this gap and the successful maintenance of the 60-mile levee

TWO SAND BOILS AT CAMP C2 IN THE BORROW PIT

front in Arkansas will completely protect an area of 7,000 sq. miles with an assessed valuation of $175,000,000 supporting a population of 200,000 people. This country has had protection from floods not exceeding 52-ft. gage height at Arkansas City. The gage during this flood was 58 ft.

Fallacies—Several views held by laymen and some held by the older flood fighters appear now to be accepted as fallacies. Perhaps the most often aired theory is that the increased height of the levees has lifted the river bed. The question was put to Colonel Potter who was encountered superintending a congressional investigating committee down the river. "Checking with the oldest records which we have, there is nothing to indicate any building up of the bed," said he.

As to whether reservoirs on the head water would prevent the floods, Benjamin H. Humphreys, congressman from Mississippi and Colonel Potter discussed this question at length and replied that the present flood discharge all came from rain that fell on areas below any of the proposed reservoir sites. In general then the 1922 flood indicates that levees are the only feasible method of protecting former overflowed areas and carrying the discharge to the Gulf.

Why do the engineers not permit the many curves and loops to be straightened is often asked. The last big change and loop cut off was at Vicksburg shortly after the Civil War. It took 50 years for the regime of the river to be re-established. About $2,000,000 was spent in putting Vicksburg back on the river by directing the Yazoo through the old channel. Ashbrook Neck held by a five-mile dike is on the third loop above Greenville. Had not the brush and concrete matts forced the water, which is 5 ft. deeper on the upstream side than on the lower side to traverse the additional 14 miles around the end of the dike, Greenville might by now have been left on a lake or it might have been engulfed by the extra horsepower made available by the 5-ft. fall.

This dike, which was built by dragline scrapers, has been held, although the water swings around the concrete end with a drop of 4 ft. and consequent high velocity. The pressure is not great but serious crumbling has been encountered. At one point one mile from the junction with the main levee a loop of bags was built in 16 ft. of water around a serious slough. About 75 ft. of concrete protection at the end was carried away but the engineers were then able to stop the crumbling by an immense sack dump. This dike, together with some of the levees in this district, are described in *Engineering News*, Dec. 14, 1916, p. 1114. A view of the protection work by a loop at the slough is shown on the plate of views in this issue.

Land-side enlargements of levees are taboo. Many of the slides and slips are along the plane joining the new and old levees. All new levees are built up on the water side.

Morale—The spirit created by dependence on local interests rather than on federal appropriation has done more than any other one thing to hold up the morale of the maintenance organization. But like meeting every crisis, the hardest task for the engineers has been to keep the men keyed up to a high state of efficiency after the crest has been reached and the river starts slowly to recede. The banks are becoming more and more saturated and factors of safety are dwindling so that in reality conditions are not in as good condition as they appear. The planter is anxious to get his farm hands back home so that the labor problem becomes acute. The engineers have had to resort to much commendable education of the public in engineering in order to maintain interest. Inspection trips are arranged, constant contact with the newspapers is maintained and officials of various cities and organizations are pitted against each other in forming future policies and carrying out relief measures. This is not exactly engineering but morale, and is largely credited with winning the river fight so far.

If the 1922 flood is handled with no further damage above Vicksburg that area with exception of the back water over the lower ends of the tributaries St. Francis, White and Yazoo Rivers, will be a most prosperous one this year, and the people in the protected areas will have the engineers to thank for their good fortune.

Hydraulic-Fill Dams Safe to Construct

Core Studies at Miami Conservancy District Dams Show Construction Hazard to Be Small If Precautions Are Taken

EXPERIENCE in constructing the hydraulic fill dams of the Miami Conservancy District indicates that: (1) the gradation of core material may be controlled during construction, even with borrow pit materials of widely different character; (2) a considerable excess of fines is required in the borrow pit material, in order to maintain proper control of the core and to prevent the encroachment of gravel and sand into the core zone; (3) a reasonably wide core, namely core width at any point equal to height of dam above that point, may be obtained with absolute safety; (4) a fairly high percentage of extremely fine material in the core is not objectionable, provided the material is properly graded; (5) such cores show a satisfactory rate of consolidation, and (6) such cores are stable, after a few months consolidation to the extent that they will not flow when the support of the outside slope material is removed.

These conclusions are stated by Chas. H. Paul, chief engineer of the flood protection work, in a paper "Core Studies in the Hydraulic Fill Dams of the Miami Conservancy District" in *Proceedings* of the American Society of Civil Engineers, March, 1922, p. 453. They are based on tests and observations when placing between seven and eight million cubic yards of hydraulic fill in five dams from 7 to 50 miles apart. Tests were made by placing Goldbeck pressure cells in the core fill as described in *Engineering News-Record*, April 18, 1918, p. 758. The general methods of constructing the dams were described in *Engineering News-Record*, Sept. 9, 16 and 23, 1920, pp. 487, 547 and 601.

Distribution of Materials—The general separation of material was obtained to the extent that the outside slope material was pervious, free-draining, and composed largely of coarse particles, whereas the cores were impervious and of fine material. The theoretical gradation of material outside the core zone, from coarse at the outside to fine toward the center, is hardly perceptible, except by careful examination, and then only in a general way. Although the material near the outside slope line contains a larger percentage of coarse particles and is more pervious than that near the edge of the core, still considerable coarse gravel is distributed through the section of the dam from the outside slope to the edge of the core, and there is considerable sand near the outside slope as well as near the core zone, which is of no importance. It is also true, however, that a considerable quantity of the fines is trapped in this outside slope material, which is of importance and must be taken into consideration in any analysis of borrow-pit material. *Unless such analysis shows a large surplus of fines in addition to that required by the theorctical core section, it is almost certain that the necessity of an additional supply of core material will develop during construction.*

At all five dams there was a distinct deposition of sand at the edge of the core pool, forming a definite separation between the slope material and the core material. The water flowing down the beaches from the discharge end of the dredge pipe, dropping the gravel and coarser material along the way, carried still an appreciable quantity of coarse sand when it reached the core pool. Its velocity was checked as it entered the pool, and its burden of coarse sand was immediately dropped, only the finest of the material, that is, the fine sand, clay, and silt, going into the core zone where it settled slowly through the core pool. This was what happened when construction conditions were right.

Irregularity in shore line, concentration of flow down the beach, deficiency of core material, and similar unfavorable conditions which continually occur on construction work, regardless of how well it is organized, occasionally resulted in tongues of the coarser material extending into the core zone, thus emphasizing the necessity of a *reasonably wide core section to take care of such contingencies* which, however undesirable, can hardly be eliminated.

Test Results—As a result of all tests with pressure sells the conclusions are that *after a few weeks the core material begins to consolidate and that after a few months the lateral pressures are about one-half the vertical pressures.* Observations where the core had to be cut through or was exposed by local washouts showed the material to be well graded, firm enough to stand for some time in vertical banks, and resistant to erosion.

Escape of Surplus water—There is difference of opinion as to how the water escapes from the core. Experience at the Conservancy dams indicates that this process is more rapid than could occur by ordinary filtration action. It is very likely that some of the water drains out laterally, but there are indications that the greater quantity is displaced and forced up, vertically, by settlement of the solids and by pressure due to the superimposed material.

There is further evidence that comparatively little of the water in the core material escapes laterally. While the dams were being built, seepage water was always in evidence at the toe of the porous slopes. This flow was greatly dimished at times when the dredge pumps were shut down and the level of the core pool had dropped 1 or 2 ft. The litle springs are still in action, and the consolidation of the core goes on, forcing the surplus water to the surface.

Gravel Slips—Once at Huffman and several times at Englewood, trouble was experienced by the gravel and sand sloughing or raveling into the core, its presence being detected by the rod soundings. In every case, this happened when the core material was not brought up fast enough to correspond with the building up of the outside slope material, and *it could always be prevented by keeping the core well filled with mud.* The coarser material takes a fairly steep slope next the core pool, and each layer overhangs the one below. Water pressure is not sufficient to hold it in place. If the core pool is kept well filled with mud, however, it consolidates fast enough to keep the coarse material from sloughing in. Here again, the advantage is apparent of having a surplus of fines in the core material so that some of the finest may be wasted.

A concentrated flow down the beach from the dredge pipe will tend to carry a tongue of gravel and sand out into the core. This may be prevented by shear boards to break up the concentration of flow, or by a floating timber held in ropes close to the shore of the core pool, at the point where the flow enters the pool. By building up the dam in lifts or not more than 2 or 3 ft. at a time, this trouble may be avoided more easily.

Caisson With Water-Ballast Tanks Lays Submerged Floor

By James A. Bjerregaard
Hydraulic Engineer, Bangor Railway & Electric Co., Bangor, Me.

An open caisson, with water-ballast tanks, was successfully used last year to replace a submerged floor of wood with precast-concrete slabs at the hydro-electric station at Veazie, Maine. By means of the water-ballast tanks the caisson was easily floated and sunk and could thus be shifted along the floor as successive sections were replaced. The drawings, Figs. 1 and 2 show the construction of the caisson and the manner in which it is floated and sunk, and the view Fig. 3 shows the entire slab-placing plant in operation.

A timber caisson of usual construction, Fig. 1, except for the water-ballast tanks and the gate valves, was built to enclose a floor space about 20-ft. square. The floor formed the bottom of the forebay and under it were the tail-race conduits formed by parallel masonry walls which carried the floor. In general the procedure was to sink and seat the caisson on a section of the floor to be replaced, then to tear out the old timber work and place the concrete slabs. The caisson was then floated and shifted to an adjacent section and the operation was repeated. A cableway brought the precast slabs from the shore to a derrick scow moored alongside the caisson and the derrick handled one slab at a time into the caisson where it was placed.

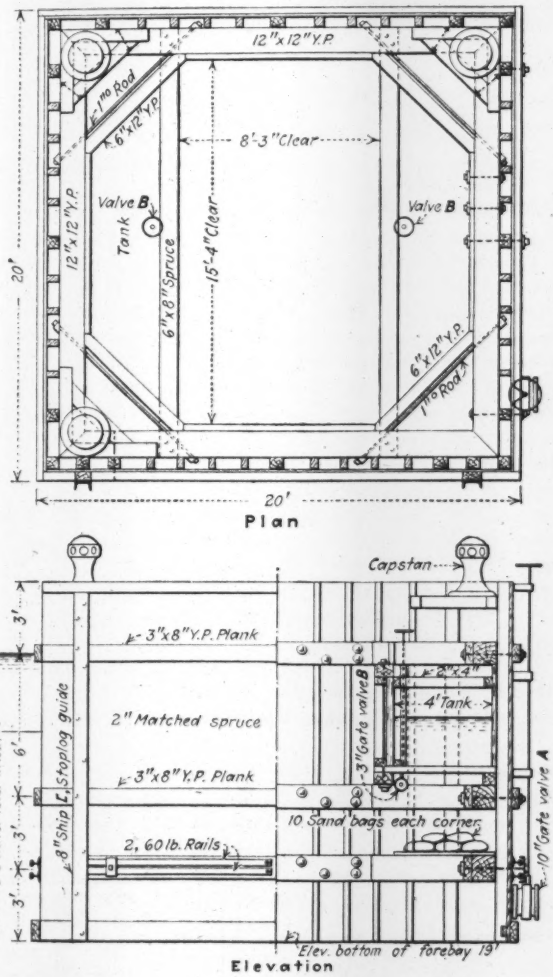


FIG. 1. TIMBER CAISSON WITH GATE VALVE AND WATER-BALLAST TANKS

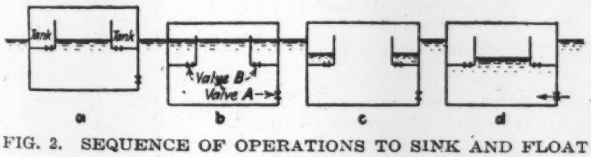


FIG. 2. SEQUENCE OF OPERATIONS TO SINK AND FLOAT CAISSON

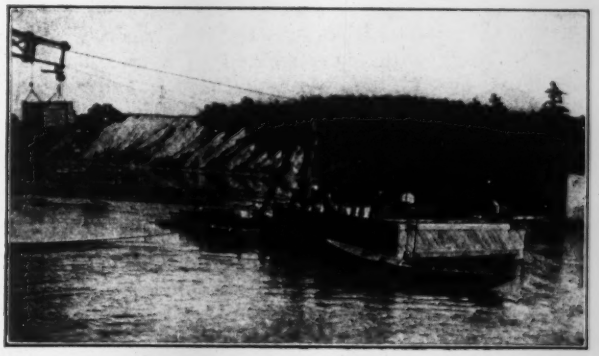


FIG. 3. PLACING SLABS WITH CAISSON, DERRICK SCOW AND CABLEWAY

The unusual procedure was the operation of the caisson by means of the ballast tanks and gate valves. With the tanks empty, the caisson was floated into position *a*, Fig. 2. The caisson was then sunk to position *b* by opening the tank valves *B*. In position *c* the caisson was drained through the floor and the work performed. With the work completed the tank valves were closed and the gate valve *A*, position *d*, was opened, thus letting in water and floating the caisson.

Although the caisson was sunk onto a fairly level and smooth floor, some difficulty was experienced in making the contact water-tight. At first a roll of canvas on an iron bar was tried without much success. If the crack was more than an inch wide, the canvas was forced through. Flaps of heavy canvas were then made with lengths of 3-in. diameter rope sewed into their lower edges. Lines attached to these flaps enabled them to be pulled up when the caisson was floated. Corner leaks and other minor leaks were stopped with gravel and cinders.

The average time required for one complete operation was:

	Hours
Raising, spotting and sinking	5
Emptying and stopping leaks	12
Removing old floor	5
Setting and grouting five slabs	8
Total	30

With one day for the grout to set, this made four days between moves, each move representing 15 ft. of floor laid.

Old Application for Imhoff Tank Granted

The process patent on the Imhoff tank applied for in 1913 has recently been granted to Dr. Karl Imhoff and Heinrich Blunk of Essen, Germany (U. S. Patent No. 1,399,561, dated Dec. 6, 1921). The fundamental claim of the patent is for "bringing decomposing sludge into intimate contact with fresh sludge."

Load Tests of Piers for Chicago New Union Station

Jacking Load of 87½ Tons Per Square Foot Gives Little Compression of Hardpan—Skin Friction of Pier in Clay

FOUNDATION loading tests on 4-ft. concrete piers 70 ft. deep, with loads carried to a maximum of 1,200 tons, or 87½ tons per square foot, and supplemented by a skin friction test, form a notable part of the studies made in connection with the design of the 20-story headhouse and office building for the Chicago Union Station Co., which is now under construction in that city.

Soil conditions at this site consist of about 70 ft. of Chicago clay (to 65 ft. below datum or river level) and 15 ft. of firm solid hardpan, followed by 3 to 4 ft. of soft clay, sand and loose wet gravel on top of bedrock. Test borings show that these conditions are fairly uniform for some considerable distance around the site. Geologists assume this hardpan to have been consolidated during the glacial period by an ice sheet 4,000 ft. thick with a weight approximating 115 tons per square foot. The compacting was done by the dragging or lateral movement of the ice sheet, rather than by direct pressure.

When the original design was made for a four-story headhouse, it was decided to support the foundation piers on the hardpan, on account of the great expense of sinking the piers to rock. This decision was made in view of the number of large buildings and bridges which have stood on similar foundations for several years without settlement, and of the further fact that the station building will occupy an entire block, so that future foundations of other buildings (at a minimum distance of 70 ft.) cannot cause undermining.

In an area 320 x 400 ft., 250 piers were sunk by the Chicago caisson or open well system to a depth of about 65 ft. below water level in the river. This work was completed in 1919. The piers are from 46 to 96 in. in diameter and are belled out or enlarged at the bottom to increase the bearing area, this being the usual practice with piers founded on the hardpan. They were figured for a maximum load of 6 tons per square foot, which is the limit usually specified by the city building department for foundations on hardpan. Tests up to 12 tons on a loaded area of one square foot at the bottom of one of the shafts or wells showed only a slight initial settlement and no subsequent movement.

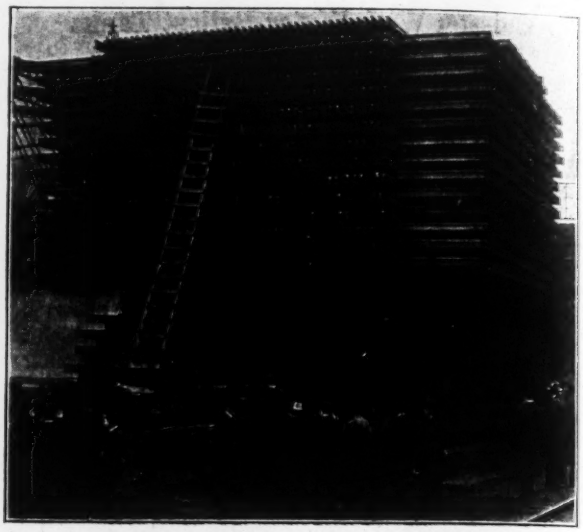


FIG. 1. LOAD TEST ON FOUNDATION PIER AT CHICAGO UNION STATION

Girders and I-beams on blocking carry 1,200 tons of rails as reaction load for hydraulic jack between girders and pier.

With a change of plan calling for a 20-story building, in order to develop the air rights for revenue producing purposes, additional foundation work presented a difficult problem. It was found necessary to make the new design without regard to the arrangement of the foundation piers already existing, but to utilize these latter where practicable.

At this stage of the proceedings the building commissioner advocated carrying the piers to rock. Such a change would increase the cost enormously, partly by the great depth of the new piers and partly by rendering the existing piers useless, since a combination of piers of different depths would not be satisfactory. Under these conditions, it was decided to test the bearing capacity of the hardpan under exceptionally heavy loading, with the hope of convincing the building department that this stratum could be used safely as the support of the building.

It was desired to avoid possible injury to existing piers by loading tests, and also to avoid the heavy expense which would have been incurred in hauling the

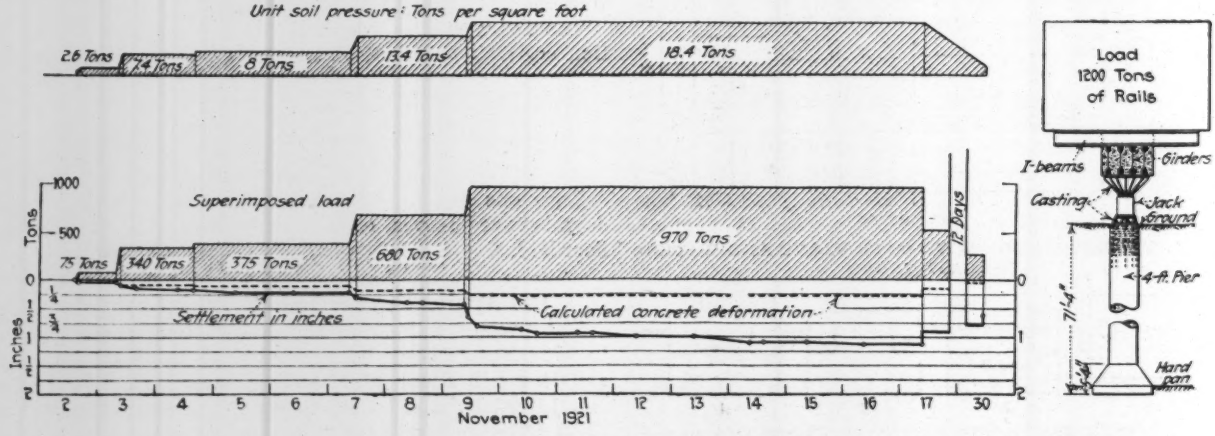


FIG. 2. DIAGRAM OF PIER LOADING TEST

test load of rails to the site. For this reason two test piers were built at the present station, where the rails and other material were delivered by cars and set in place by a locomotive crane. Wood-lined shafts or wells, 4 ft. in diameter, were sunk in the usual way by hand excavation to a depth of about 70 ft. below the ground-level or 65 ft. below datum. A 12-ton test on a loaded area of 1 sq.ft. at the bottom of each well resulted in only slight initial compression.

One of these piers was cylindrical for its entire depth, with a base area of 14.5 square feet. The other was belled out at the bottom in the manner usually employed for piers founded on the hardpan, giving a diameter of 8 ft. 4 in. at the base, with an area of 56.7 square feet. Concrete was a 1:2:4 mix, made with 1-in. broken stone, except that for 4 ft. from the top a 1:1:2 mix was used and was reinforced by vertical bars and a steel spiral to prevent crushing or spalling under load. This concrete was spouted into the wells and had a free fall to the bottom. The wood lining was left in place, but the steel ring braces were removed in the upper part of the shaft as the concrete reached them.

It was intended to carry the load up to 1,000 tons, but the balancing of a 1,000-ton load of steel rails on a 4-ft. pier would have been a troublesome matter. The plan adopted, therefore, was to place about 1,200 tons of rails over the pier but supported by blocking, and to employ this load as the resistance for a 1,000-ton hydraulic jack seated on the pier. This jack was built specially for the test. A cast steel base distributed the load over the entire top surface of the pier. Upon the jack was placed another casting in the form of an inverted pyramid to carry a group of four plate girders, 44 ft. long, with concrete packing between them. Across these girders were laid sixteen 24-in. I-beams forming the seat for the pile of rails. This method of loading was described in *Engineering News-Record* of Nov. 10, 1921, p. 763. From the view of this reaction load, Fig. 1, it will be seen that the ends of the girders and I-beams rested on blocking.

A hand-pump with ⅝-in. plunger of 1-in. stroke forced oil to the jack, the plunger of which was 21 in. in diameter. In addition to the usual pressure gage a boiler draft-gage was arranged to show the movement of the pier. This gage consists of a graduated glass tube 20 in. long, slightly inclined from the horizontal and containing a red liquid with a travel of 5 in. The tube was connected to a vertical 2-in. cylinder 10 in. high, mounted on a steel rod standing on the concrete pier, this chamber forming a reservoir for the gage liquid. As the cylinder dropped with the settlement of the pier it lowered the level of the liquid in the tube of the gage.

Levels were taken at frequent intervals, as well as direct measurements of the movement of the jack. The concrete was 30 days old before the loading began.

Test on Belled Pier—The first test was made on the pier with the belled base, and a diagram of this test is given in Fig. 2. At 430 tons (or a unit load of 7 tons per square foot) the settlement was less than ¼ in., and about half of this was the calculated deformation or compression of the concrete. This settlement took place on the first day and did not increase. On the fourth day the load was increased to 375 tons, causing 1/16-in. additional settlement. No further movement occurred until the load was increased to 680 tons (12 tons unit load) on the seventh day. The total settlement was less than ½ in. and practically half of this was in the concrete column.

With the load increased to 970 tons on the ninth day (18½ tons unit load) the settlement increased 7/16 in., and then continued gradually until it reached a total of about 1¼ in. On removing the load some days later, this settlement was reduced about ¼ in. by the elastic recovery of the concrete and the hardpan. Three days later this recovery had increased to about ½ in.

Test on Cylindrical Pier—A slower rate of loading was employed in the test of the cylindrical pier, to which the rails and apparatus were transferred after the completion of the test on the first pier. A load of 149 tons (11.4 tons per square foot) was carried without any settlement. On the eighth day this was increased to 640 tons (31 tons unit), increasing the settlement to 1 1/16 in. This load was maintained for seventeen days,

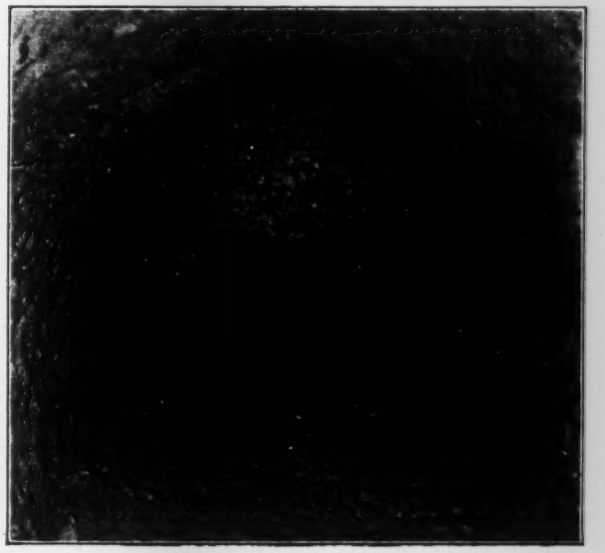


FIG. 3. INSPECTION TUNNEL FOR THE LOAD TEST
Showing bottom of pier exposed for test of skin friction.

but the settlement increased only 1/16 in., or a total of 1⅛ in.

The load was then increased to 1,000 tons. At this juncture the commissioner of buildings expressed a desire to see something move and the load was pumped up to 1,200 tons, the jack then lifting the reaction load clear of its blocking. Following this spectacular movement the load was reduced to 1,000 tons. For the 22-day period of this test the total settlement was about 2 in., and after the load had been removed there was a recovery of ⅞ in. The maximum unit load applied, without allowance for skin friction, was 87½ tons. In both tests the results were practically identical.

Tests of Skin Friction—For the purpose of examining the first test pier, a 4-ft. well was sunk in contact with it, the wood lining being omitted for a vertical strip about 1 ft. wide. Removal of the wood lining of the test pier disclosed a smooth and dense concrete surface. The shaft was carried down below the base of the pier, cutting through the bell. Samples of concrete from the bell showed concrete of excellent condition. This had been expected, owing to the hydrostatic pressure in the column of wet concrete.

From this inspection shaft a tunnel 6 ft. high and 4 ft. wide was driven for a distance of 45 ft. to and

beneath the bottom of the cylindrical pier. No timbering was required in this tunnel. Fig. 3 shows this tunnel, with the bottom of the concrete pier exposed at the far end.

With all material excavated from under the base of the pier, so that it was held only by skin friction in the clay, load was applied until the pier had been driven down 6 in. In this movement the hardpan in the roof of the tunnel was disturbed only for a distance of 2 ft. from the concrete plug. No movement occurred until the load reached 100 tons, but at 250 tons the pier began to go down slowly, so that it was not practicable to get a pressure higher than 260 tons.

Thus the skin friction would be 250 tons plus the 65-

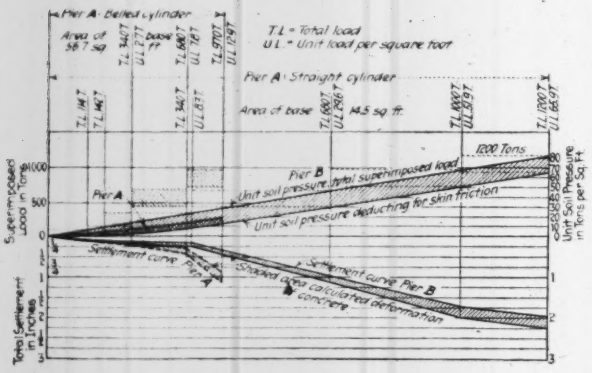

Pier A: Belled cylinder
Area of base 78.7 sq. ft.
TL = Total load
UL = Unit load per square foot
Pier A: Straight cylinder
Area of base 14.5 sq. ft.
1200 Tons
Pier B
Pier A
Unit soil pressure (total superimposed load
Unit soil pressure deducting for skin friction
Settlement curve Pier A
Settlement curve Pier B
Shaded area calculated deformation of concrete
Superimposed Load in Tons
Unit Soil Pressure in Tons per Sq. Ft.
Total Settlement in Inches

FIG. 4. DIAGRAM OF LOADING AND SKIN FRICTION TESTS

ton weight of concrete, or 315 tons for a cylinder 4 ft. in diameter and 70 ft. in the ground. This would have been decreased later due to the smooth surface caused by the movement. The timber lagging went down with the concrete cylinder pier, sliding in the clay. The skin friction may be taken as 700 lb. per square foot of the cylindrical surface, 888 sq.ft.

Compression stress in the concrete under the maximum load of 1,200 tons was 1,750 lb. per square inch at the top of the pier, and 1,400 lb. at the bottom. Tests of the crushing strength of this concrete showed an average of 2,410 lb. at 14 days, 3,390 lb. at 28 days and 3,720 lb. after three months. Fig. 4 is a diagram of both tests and shows the relation of skin friction to unit load at base of pier.

Conclusions—From these tests the conclusion is drawn that the allowable pressure on the hardpan stratum can be increased from the present 6-ton limit to 10 tons per square foot without any risk. This increase would be sufficient for the foundations as proposed for the 20-story building.

Based on the information acquired, the plan proposed is to sink a number of additional piers at points required by the design of this building. At some points the new pier will be close to an existing pier, with its bell overlapping that of the latter. The two piers will then be capped by a distributing girder carrying a column of the building.

These tests were planned and carried out under the direction of J. D'Espositó, chief engineer of the Chicago Union Station Co., and A. J. Hammond, assistant chief engineer, in co-operation with the architects, Graham, Anderson, Probst & White.

Applying Machinery to Railway Maintenance of Way

Enormous Aggregate Economy Seen in the Use of Labor-Saving and Material Handling Devices for Track Work

MANUAL labor in railway maintenance is becoming a seriously costly feature of operating expenses owing to the great army of men employed and the higher rates of pay now imposed on the railways. At the same time the conditions under which the work is done are unfavorable to efficiency and economy of labor. These circumstances have tended to cause a steady increase in the introduction of mechanical appliances to replace large forces of unskilled and seasonal labor. This subject has been dealt with in a paper read before the Western Society of Engineers by Robert H. Ford, assistant chief engineer of the Chicago, Rock Island & Pacific Ry. An abstract of this paper is given below:

Railway Labor—About 60 per cent of all railway employees are engaged in maintenance, the greater part being in maintenance of roadway, and of this proportion approximately 75 per cent are untrained workers. In 1921 about 460,000 men were required in roadway maintenance and $354,000,000 (about 54 per cent of the maintenance outlay) was expended for roadway and track repairs. Our conditions are such that the roads must depend upon the seasonal or extra-worker for the greater part of the annual maintenance program.

Time studies of seasonal or extra-gang labor have shown productivity to range from 28 to 33 per cent. The regular section gangs rank higher than this, but the effect of years of low rates paid to this class of really skilled labor has been to lower the standard and drive from its ranks much of the desirable material. In general the productivity of railway maintenance labor has not been commensurate with the results secured in other lines of industrial endeavor. Specialization in railroad maintenance has lagged far behind other lines of industry. This is not due to a failure on the part of the railroads to appreciate the importance of such matters, but to the fact that for years the roads have been too poor to be economical.

Roadway Ditching—The roadway must be continually drained and ditched, approximately $31,000,000 being expended annually for this work. In former years the work was performed entirely by manual labor at a cost of 10 to 25c. per yard. Today it costs 75c. to $2 per yard by hand or 50c. to $1.75 by teams. A self-propelled ditcher consisting of a small 14-ton steam shovel working from a flat car was introduced a few years ago and has afforded great opportunities for labor reductions in this direction. One of these machines will perform the work of 75 to 100 men. Flat cars have given way to air-dump cars with the steam ditcher placed between them. These machines can be put to a variety of uses such as handling coal and loading and unloading various classes of material.

A comparatively recent innovation is the ditcher-spreader consisting of a steel car equipped with wings similar to an ordinary spreader (for which it is also used) but with the addition of a detachable cutting edge shaped to the standard ballast section. In one operation this machine clears the ditches, shapes the subgrade from the ballast toe to the shoulder of the roadbed and also cuts and cleans the ditches beyond the roadbed. (see *Engineering News-Record*, March 9, 1922, p. 390). The machine is pushed by a locomotive and will complete from 10 to 25 track miles per day, ditching on both sides where necessary. It does the work of several hundred men at a cost of 2 to 6c. per yard. This machine can also dig new ditches, but its main advantage is to keep the ditches clear. The steam ditcher is most economical in long, heavy or sliding cuts.

In certain sections of the country right-of-way ditching

is necessary near the fence line. As a rule these ditches are deeper and larger than those along the roadway and construction by manual labor is expensive. A ditcher-tractor offers many attractive possibilities for reducing labor requirements on work that cannot be reached directly by machines operated from the track.

Unloading Earthwork—In strengthening and widening embankments it has been customary to use flat cars unloaded by means of a plow on the rear car and drawn through the material by the cable of a winding machine at the head end of the train. It was necessary for gangs of men to go between the cars (unless special aprons were provided) and shovel out the accumulations of dirt resulting from moving the plow over the cars. After the train moved out of the way, the spreader placed the larger part of the material on the widened embankment, the remaining portion being removed and placed by hand.

The air-dump car operated direct from the locomotive and loaded by the locomotive crane, steam shovel or other appliance has largely replaced the plow system and its large labor gang. A skillful operator can dump the cars at will with the train in continuous motion. The latest type is arranged with an apron extension so that the material can be dumped clear of the ballast and then followed up by a spreader where necessary.

Motor Cars—The section motor car is replacing the old hand-operated car and has now become an essential for track maintenance, both as a means of economizing labor and reducing expenditures.

Rail Renewal Devices—In renewing rails it is practicable to do the greater part of the work by mechanical means, from the unloading of the new rails until the released rails and fastenings are placed on cars ready for shipment. Pneumatic drills, power bonding machines and power track wrenches are some of the several labor-saving devices that reduce the cost of this work and will permit increased efficiency and economy.

The labor cost of laying rail varies from $700 to $2,000 per mile, the large fluctuation being influenced largely by operating conditions and facilities. A fair cost today is probably about $1,400 a mile but, it will be practical to do this work by mechanical means for about one-third this sum. Last year $20,000,000 was expended for labor in this work.

Handling Rails—A pneumatic hoist mounted or built on a flat car equipped with a derrick at each end and placed between two flat cars, will load the equivalent of two miles of rail at about one-tenth the cost by former methods with large labor gangs. A light derrick truck that can be lifted from the rails by three men is now available for use at large terminals in moving frogs, rails, switch material and heavy timbers.

Locomotive Crane—A locomotive crane will do about everything required in lifting, placing and transferring material, pile driving, erecting, digging and any work of this class where manual labor has been necessary. The range of use of these machines is entirely a matter of education. Not only are they extremely valuable in maintenace of way but they are adaptable for various other lines of work.

Track Oilers—To prevent corrosion of rail fastenings, spikes, bolts, tie-plates and even the rail itself by brine drippings from refrigerator cars, these metal parts are oiled periodically and the work is usually done by track labor. The cost of oiling joints only by machine runs from $3.50 to $7 per mile (depending largely on the cost of the oil). This is far below that for manual labor.

Mowing and Killing Weeds—American railroads spend about $30,000,000 annually for clearing the weeds from their track, with an addition of about $16,000,000 for keeping the right-of-way clear of brush and weeds. It is customary to do much of this work by team mowers or by hand, since there is so much broken or rough and rocky land. There is a great opportunity for saving by development of the tractor and sicklebar, both of which are now in use to a limited extent.

Cutting weeds forms one of the principal jobs of section labor and requires the services of over 100,000 men for five months of the year. A weed burner, operating twice during the season, will remove the weeds at a cost of $14 per mile per trip as compared with $135 for hand labor. This is only one of several devices for the purpose. On branch lines the ballast shoulders can be taken care of by the disc weed-cutter at a cost of about $4.50 per mile as compared with $25 for hand labor. Track mowing machines consist of a sickle bar attached to a motor car and adjusted to cut the weeds 6 ft. from the rail. These machines operate at 4 to 6 miles per hour and the work costs $5.50 per mile as compared with $40 per mile for both sides of the track by hand labor.

Destruction of weeds by chemical process is both possible and practical, although the field is open for further development. The time is not distant when a great part of the money now spent annually for weeding will be saved because chemical and mechanical means will render this labor cost unnecessary.

Tie Tampers—One of the largest items in roadway maintenance is the labor required to maintain the track in uniform surface. Approximately $44,000,000 is expended annually for this work which is almost exclusively a labor item and is performed by the section and extra gang forces. Tie-tamping machines operated both electrically and by compressed air reduce the cost by 70 per cent or more. In general these machines are better adapted for rock and heavy ballast than for light material and for this reason there is considerable room for further development. One trunk line is using a pipe line which parallels its track for over 100 miles to furnish compressed air for track tools.

Cleaning Ballast—Ballast becomes foul by use and must be either shoveled out by hand and wasted on the adjoining slopes or cleaned by screening. Many roads do the latter work by hand, but there are power-operated ballast screens that greatly decrease the cost and also conserve the ballast supply. Picking up scrap and cleaning the right-of-way and yards falls to the maintenance laborer. There are many opportunities for saving by means of local appliances that help to reduce the labor required. The tractor crane or locomotive crane equipped with a magnet offers great opportunities in this direction, especially when combined with its facilities for handling, collecting or piling miscellaneous material.

Railway Inventions—The patent office is full of discarded inventions for railroads that are theoretically good but practically impossible. A thorough understanding of the principles involved is absolutely necessary and the man unfamiliar with railway operation is handicapped until he can properly inform himself or co-operate with railroad men.

Railroad men of inventive turn of mind who will study railroad problems have a good start in this direction. Essential requirements are well grounded knowledge of costs under existing conditions, the experience of others on proposed remedies and their reasons for failure and also a knowledge of the cost of the proposed devices. With this there must be a willingness for investigation and the patience and perseverance which the inventor usually has. The main question is whether the device is conservatively safe, cheap, simple and essential. In conclusion it may be said there is a great field for design and standardization in railway labor saving devices.

Population of France and Its Largest Cities

The population of France as of March 6, 1921, according to recently published census figures, was 39,402,739. There were 15 cities with populations of 100,000 or more, headed by these five: Paris, 2,906,472; Marseilles, 586,341; Lyons, 561,592; Bordeaux, 267,409; Lille, 200,952. The decline in population from 1911 to 1921, after allowing for 1,710,000 added by the annexation of Alsace-Lorraine, was about 2,000,000.

Analysis of Connecticut's Traffic Census Data Yields Facts on Truck Overloading

Digest of Report Made for U. S. Bureau of Public Roads Shows Every Third Truck to Be Loaded Beyond Capacity of Truck and Tires

By J. Gordon McKay, Ph.D.
Professor of Economics, University of Wisconsin

TO SECURE data for an analysis of motor-vehicle traffic on trunk-line highways, with particular reference to truck overloading, a comprehensive study involving records of 75,000 vehicles, was made last year by the Connecticut Highway Department in co-operation with the U. S. Bureau of Public Roads. This survey (described in detail in *Engineering News-Record*, Jan. 12, 1922, p. 48) consisted of two traffic censuses, the first, at Enfield, covering the period Aug. 16-29, on the Hartford-Springfield road, and the second, at Greenwich, Oct. 3-16, on the Boston Post Road near the New York State line. In addition to the usual numerical count information was secured regarding weight of vehicle (by means of roadside scales), dimensions, commodity carried, length of haul, tire equipment, rated capacity and other details. Based on the data thus secured the following analysis from a report made for the U. S. Bureau of Public Roads, is presented. For the federal government Thomas H. MacDonald, chief of the Bureau of Public Roads and for the State of Connecticut, Charles J. Bennett, highway commissioner, were the representatives.

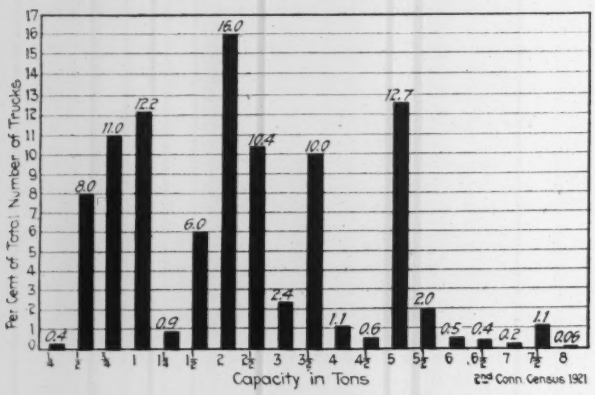


FIG. 1. COMPOSITION OF TRUCK TRAFFIC (SECOND CENSUS)

Based on rated load-carrying capacity. Only 4.2 per cent of trucks exceed 5-ton capacity.

Factors in Transport Problem—The production of highways and of vehicles which utilize them represents two industries in which the yearly investment exceeds by far any other two industries in the United States. The interests of the highway engineer and the producer of motor vehicles are largely the same—the one to construct and maintain highways which will carry a maximum of traffic of economical weight units at a minimum cost, and the other to produce vehicles which will move the traffic at a minimum cost and with the least damage to the highway. We cannot afford the waste of building roads to carry all types of traffic and unlimited loads, nor can we fit the vehicle to all types of highways. It is a combination of both—the building of suitable and satisfactory roads and motor vehicles of the proper construction and weight. This is a joint industry of the road-maker and the road-user with a common object: the production of transportation at a minimum cost.

One of the most serious difficulties confronting the highway engineer today is the construction of roads which will remain in existence long enough to justify the investment and at the same time withstand the hammering of the steadily increasing volume of weight to which the pavement and subgrade are subjected. This presents a twofold problem: First, excessive loads beyond a given maximum weight which results in the premature destruction of the highway. Second, overloading per capacity.

We must fully recognize the necessity of automotive transportation and the need for construction which will carry modern traffic, but first we must determine the economic load units and, second, eliminate overloading. The weight of single units and speed are the two essential points of difficulty. The greater the speed of heavy loads the more damage to the highway. The ratio of damage to the road with an increase in speed is altogether out of proportion to the economies gained by faster movement.

It is not contemplated that we will ever construct our secondary highways to carry the maximum loads imposed on our primary roads. To prevent the destruction of our secondary systems by heavy trucking a classification of highways, based upon evidence and not mere belief, is necessary. Maximum weights of vehicles moving over each type of highway must be specified. Recent load restrictions in Wisconsin limit the market for sale of heavy-duty trucks. Strict supervision of weight of vehicles and severe penalties for violation of load limits are essential in order to compel obedience to law regulating the maximum and capacity weights which may move on the highway.

In Maryland all loads in excess of 10 tons, vehicle and load, are forced to unload excess weight and leave it on the highway. Ohio orders overloaded trucks off the road. Gross weight limits in the various states range from 6¼ tons maximum in Vermont to 15 tons maximum in California, Michigan and New Jersey. About one-half of the states specify a maximum load per inch of tire width ranging from 500 lb. in Idaho, Oregon, and Texas, to 800 lb. in Connecticut, Illinois, Iowa, New Jersey, New York, Pennsylvania, Washington, Wisconsin, Minnesota, Massachusetts, Maine and Kentucky. (See article, "The Trend of Motor Vehicle Legislation," *Engineering News-Record*, Sept. 1, 1921, p. 354.)

Regulations as to gross weight and overloading must take into consideration two road factors: First, the difference in road types, permitting heavier gross loads and loads per inch of tire width on the more durable types. Second, load restrictions during the early spring when the pavement is most easily destroyed.

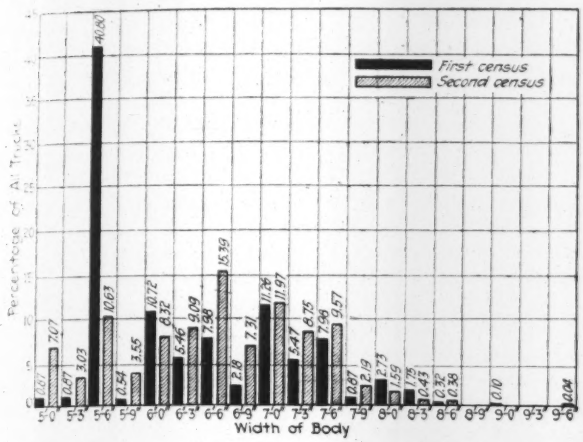


FIG. 2. VARIATION IN BODY WIDTH (BOTH CENSUSES)

Figures cover 2,993 vehicles; only about 5 per cent of truck-body width exceed 7 ft. 6 in.

The limitation of loads to 25,000 lb.—the allowable maximum in Connecticut—does not prevent the overloading of trucks whose rated capacity falls below the maximum load provision.

Methods Employed—At each of the Connecticut traffic census stations the width of tire was taken by measuring the impression made by the wheel load, front and rear, after passing over strips of impression paper. The front- and rear-axle weights were procured in order to determine the total load and the distribution of load on front and rear axle. From these figures the wheel load per inch of tire width for each truck, make and capacity was determined. The make and capacity of the truck were necessary in order to compare the manufacturer's total weights and percentage distribution of weights on front and rear axle with the actual weights recorded and thus arrive at the overloads per capacity.

Any analysis of overloading has certain limitations in the present state of highway research: (1) The lack of maintenance-cost studies of the highways on which the surveys occurred does not permit of establishing accurately the direct relationship which exists between overloading per capacity and high maintenance costs; (2) the effect of overloading on the pavement and subgrade can best be shown when correlated with impact studies of the several pavement types; (3) the overload data may be criticized on the basis of the standard used in determining overloads.

The weight standard used in this analysis for determining overloads for each make and capacity of truck consists of a summation of the manufacturers' 1920 weights for the chassis, body and rated capacity, giving the total weight when loaded to capacity. The percentage distribution of weight recommended by the manufacturers of trucks for front and rear axle load is used as a standard for determining overloads on the front and rear axle. In order to be conservative 5 per cent of the total chassis, body and capacity weight was added to the manufacturers' given weight and used as the standard for computing overloads per capacity. One-half of this 5 per cent was added to the front and rear-axle standard weights in arriving at overloads for the front and rear axles. For example, if the chassis weighs 7,000 lb., the body 1,600 lb., capacity 7,000 lb., a total of 15,600 lb., 5 per cent of 15,600 lb., or 780 lb. was added, making a standard for total overloads for this capacity of 16,380 lb. To the front and to the rear-axle weights 390 lb. was added and the totals used as a standard for judging the front and rear-axle overloads. This basis seemed fair, and even an allowance of 10 per cent would have made little material difference in the following results.

Commodities and Overloads—It has been generally believed that overloading has occurred primarily with trucks loaded with sand, gravel, brick, cement and lumber, and that this abuse has been restricted to a relatively small group of commodities. We find, however, that the practice is restricted to no typical groups of commodities, but is almost universal. For example, the loads in Table I are typical.

The types of commodities in which overloads occur per capacity, excluding all commodities in which the number of cases of overloads are less than four, range from apples to wire. Of the cases cited 75 per cent of the overloading was practised by regular trucking vehicles.

The commodity loads exceeding 25,000 lb. in the

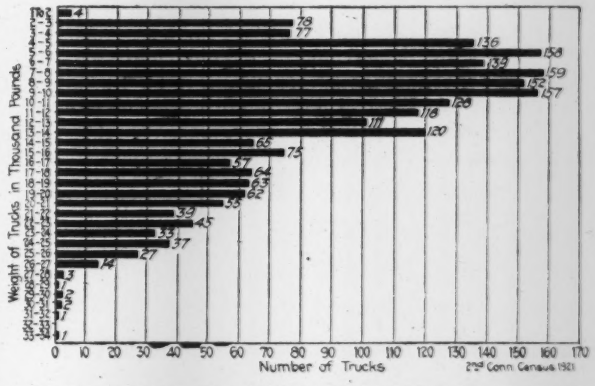


FIG. 3. CLASSIFICATION BY GROSS WEIGHT (SECOND CENSUS)

Only 51 out of a total of 2,183 trucks, or 2.3 per cent, had gross weights exceeding 25,000 lb.

TABLE I—NUMBER OF OVERLOADED TRUCKS OBSERVED AND TYPES OF COMMODITY HAULED, SECOND CONNECTICUT CENSUS

Commodity	Number of Overloads	Regular Trucking	Irregular Trucking
Apples	7	7	
Bananas	8	8	
Beer	18	15	3
Butter and eggs	6	5	1
Cocoa beans	6	6	
Crockery	4	3	1
Drugs	9	7	2
Dry goods	9	7	2
Feed	4	4	
Fish	10	7	3
Fruit and vegetables	17	15	2
Furniture	20	8	12
Grapes	9	5	4
Groceries	51	46	5
Household goods	22	7	15
Lumber	13	4	9
Litharge	6	6	
Machinery	5	2	3
Meat products	15	11	4
Merchandise	9	7	2
Paper	4	4	
Potatoes	4	3	1
Poultry	15	10	4
Rubber goods	9	9	
Silk	10	10	
Sugar	18	12	6
Tarvia	4	3	1
Vegetables	16	14	2
Vinegar	5	2	3
Wire	8	8	
Totals	344	257	87
Percentage		75%	25%

Note: Products overloaded numbering less than four cases not included in tabulation.

TABLE 2—NUMBER OF COMMODITY LOADS IN EXCESS OF 25,000 LB., SECOND CONNECTICUT CENSUS, 1921

Commodity	Loads	Overloads Per Capacity	Regular Trucking	Irregular Trucking
Brick	2	2	2	..
Butter	1	1	1	..
Cocoa beans	5	1	5	..
Drugs	1		1	..
Eggs	1	1	1	..
Fruit	6	5	6	..
Glass	1	1	1	..
Groceries	6	6	6	..
Litharge	3	3	3	..
Meat	2	2	2	..
Plumbing supplies	1	1	1	..
Rubber	5	4	4	1
Sugar	8	8	5	3
Tarvia	2	2	2	..
Valves	1	1	1	..
Vegetables	1	1	1	..
Vinegar	4	4	3	1
Totals	49	43	44	5
Percentage		87.8%	88.7%	11.3%

second census include such articles as Table 2 indicates. Of the total number in excess of 25,000 lb. gross weight 87.8 per cent were overloads per capacity and 88.7 per cent were overloads by regular trucking vehicles. In 39 out of 41 cases loads from 846 to 1,560 lb. per inch of tire width on the rear axle were observed.

Composition of Truck Traffic—Fig. 1 indicates principally the small percentage of vehicular movement above the 5-ton capacity truck—only 4.2 per cent of the total. This is not attributable to limitations of the Connecticut law, since a considerable portion of the traffic passing over the main highways on which the

Classification by Tire Types—Very few cases of heavy loads occur in which either pneumatic or a combination of pneumatic and solid tires are used. Trucks equipped with pneumatic tires, as indicated in the second census, are used largely in the lighter loads and smaller capacities, increasing rapidly from 2,000 to 5,000 lb. and decreasing rapidly to 10,000 lb. The number in excess of 10,000 lb. is negligible. The solid-tire type begins to increase rapidly at 5,000 lb. while the use of the pneumatic rapidly decreases. The combined solid-and-pneumatic-tire types are used by trucks in the weight classification between 3,000 and 14,000 lb.

The first-census data agree in general with the second census, noted above. Pneumatic tires and combination pneumatic-and-solid are used largely by lighter capacity trucks, and for lighter loads, increasing rapidly in the case of the pneumatic-tired trucks from under 3,000 to 5,000 lb. and rapidly decreasing at 7,000 lb. The general trend in both cases is the same.

Classification by Weight—The density of movement is shown by Fig. 3 (for the second census) as falling between the 4,000 and 14,000-lb. classes. A second interesting fact is the number of loads in excess of 25,000 lb. (the allowable maximum in Connecticut); they totaled only 51 out of 2,183, or 2.3 per cent. A maximum limit of 28,000 lb. gross weight would be of little value, since it would admit practically all of the traffic passing over the Connecticut highways. In the first census on the Boston Post Road near the New

TABLE 3—CONSOLIDATED TABLES OF NUMBER OF OVERLOADS PER CAPACITY, 1ST AND 2ND CONNECTICUT CENSUSES

I. Overloads Per Capacity

	¾ Ton		1 Ton		1½ Ton		2 Ton		2½ Ton		3 Ton		3½ Ton		5 Ton		6 Ton		7½ Ton	
	*L	*OL	L	OL	L	OL	L	OL	L	OL	L	OL	L	OL	L	OL	L	OL	L	OL
1st Cen.	129	55	135	28	30	18	158	84	11	4	4	4	94	55	94	47	2	0	2	0
2nd Cen.	151	66	131	24	88	35	503	169	131	59	4	1	350	125	352	126	20	7	34	3
Total	280	121	266	52	118	53	661	253	142	63	8	5	444	180	446	173	22	7	36	3
Percent		43		20		45		38		44.5		62.5		40.5		40		32		8

Weighted average overloads 39%

II. Overloads, Rear Axle

1st Cen.	129	44	135	26	30	13	158	82	11	6	4	4	94	52	94	49	2	0	2	0
2nd Cen.	151	53	131	17	88	33	503	171	131	51	4	1	350	124	352	152	20	5	34	3
Total	280	97	266	43	118	46	661	253	142	57	8	5	444	176	446	201	22	5	36	3
Percent		35		16		39		38		40		62.5		40		45		23		8

Weighted average overloads rear axle 37.5%

III. Overloads, Front Axle

1st Cen.	129	42	135	63	30	16	158	62	11	4	4	4	94	53	94	25	2	0	2	0
2nd Cen.	151	106	131	15	88	41	503	163	131	81	4	1	350	174	352	74	20	13	34	4
Total	280	148	266	78	118	57	661	225	142	85	8	5	444	227	446	99	22	13	36	4
Percent		53		29		48		34		60		62.5		51		22		59		11

Weighted average overloads front axle 40%

* Note: L=Loads; OL=Overloads.

data were obtained carried interstate traffic passing through Connecticut.

Width of Body—Fig. 2 indicates that by far the greater majority of truck-body widths are 7 ft. 6 in. or less. In the first census 914 truck bodies were measured, of which 53, or 6 per cent, exceeded 7 ft. 6 in. In the second census 2,079 body widths were measured, 102 of which, or 5 per cent, exceeded 7 ft. 6 in. A considerable portion of this excess was made up of vehicles with special-width bodies.

There is a direct relation between the speed and body width of trucks and width of the road surface. The wider the body and the greater the speed, the wider the pavement. Since an overwhelming majority of the trucks are less than 7 ft. 6 in. in width it would seem fair to restrict body width to that maximum, with a resulting saving in highway construction costs.

York Line, one of the heaviest truck-traffic roads in the country, only 7 out of 2,183 loads would have been in excess of a 28,000-lb. maximum. The density begins to fall rapidly for loads over 25,000 lb., indicating that this maximum is more nearly correct.

Weights per Inch of Tire Width—The analysis of weights per inch of tire width shows some interesting facts. We may have overloading on the front or the rear axle without having an overload per capacity. This is dangerous in that a shifting of the load to the front or rear, producing an excessive weight on either axle above standards, results in increased impact and destruction of the highway.

In the first census overloads on the front axle in excess of 800 lb. per inch width of tire number 29 cases in a total of 226, or 12.8 per cent. Overloads on the rear axle in excess of 800 lb. per inch of width

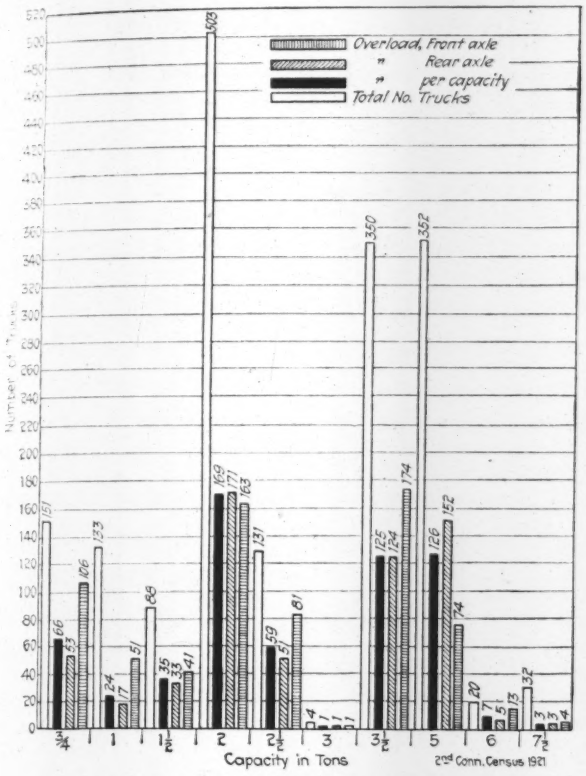


FIG. 4. TRUCK OVERLOADING PER CAPACITY (FIRST CENSUS)

More than every third truck (39 per cent) on the Connecticut highways was found to be loaded beyond the capacity of the truck and tires. Rear-axle overloads occurred in 37.5 per cent, and front-axle overloads in 40 per cent. of the cases recorded. The rear-axle overloads are more serious from the point of view of road damage.

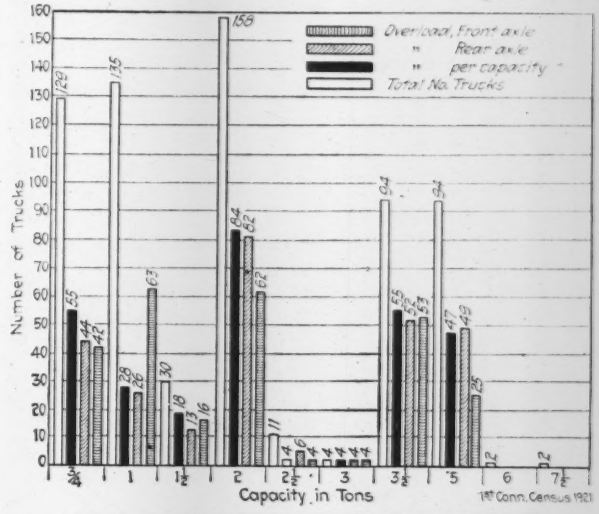


FIG. 5. TRUCK OVERLOADING PER CAPACITY (SECOND CENSUS)

number 138 cases in a total of 259, or 38.4 per cent. The number of overloads on both axles is 167 in a total of 585 cases, or 28.5 per cent. Overloads on the front axle range from 800 to 1,100 lb. per inch of width, density occurring approximately at 900 lb. per inch of width. On the rear axle overloads occur from 800 to 1,650 lb. per inch width, density occurring at 1,100 lb.

There is a close agreement of the overloading data in both censuses, although the traffic volume in the second exceeded the first. In the second census the per cent of overloads, front and rear axles is 24.6 per cent; overloads front 11.9 per cent; overloads rear, 36.5 per cent. In the second census the range of overloads on the front axle vary from 800 to 1,500 lb. per inch of tire width, while the rear-axle overloads range from 800 to 1,925 lb. per inch of tire width. The density of overloads, front axle, in the second census is 950 lb., while the density of the rear-axle overloads is 1,100 lb.

In both censuses the trend of the overload is to increase with thickness of tire to a certain thickness and then decreases. Beginning with 1 in. thickness of tires, the overloads increase, reaching a maximum with 1½ in. of thickness and decrease again as we approach 2¼ in. of tire thickness.

Of all the charts and data presented Figs. 4 and 5, showing an analysis of truck overloading per capacity for the first and second Connecticut censuses are the most interesting. There can be little room for doubt that overloading exists. The weighted average overload per capacity (in Table 3) of 39 per cent means that more than every third truck on the highway was loaded beyond the capacity of the truck and tires. Unquestionably highway damage occurs with this extraordinarily high percentage of overloads. It is not only the problem of total overloads per capacity, but overloads on both front and rear axle. The rear-axle overloads, of course, are the more serious since the greatest weight distribution is placed upon the rear axle. A total of 37.5 per cent of all loads moving on the highways surveyed were overloaded on the rear axle. Further, 40 per cent of all trucks observed were overloaded beyond the load permissible on the front axle. It will be recalled that 5 per cent was added to the total gross weight to be conservative. In the light of the percentages just given even a safety factor of 10 per cent additional weight would make little difference.

Responsibility for Overloads—This analysis presents the problem of truck overloading. Who is responsible for the rapid destruction of highways under frequent recurrence of overloads? The highway engineer? He cannot be held responsible for the rapidly growing volume of truck traffic of excessive vehicle weights and speed. He is confronted on the one hand by destruction of new and old roads, and on the other with little or no knowledge of what to expect of future traffic. Is the fault that of the manufacturer producing trucks with inadequate tire equipment? The fault is not entirely his. Not knowing in many cases the type and weight of body which is to be built on the chassis we cannot hold him to account for overloads due to excessive body weights. Is it the fault of the individual owner of trucks? In the majority of cases the blame belongs to him and in addition some responsibility is attributable to the designer of motor trucks for not specifying tire equipment to carry more than the maximum load. There is some truth in the suggestion that the manufacturer who does not produce a vehicle with a complete body cannot regulate the body size and consequently the loads to be carried. Of course an increase of the tire width would provide for these cases of overloads. Neither can the manufacturer control the loading of the vehicle or the distribution of weight. The entire load may be on the rear axle or distributed more on the front axle than is safe.

It is not the purpose of this discussion to attempt to settle the responsibility for overloading. The facts speak for themselves. We are confronted with the practice of overloading even beyond what we believed in the past.

Conclusions—The following are the more important conclusions to be drawn from the study of truck traffic in Connecticut:

1. Overloading occurs in practically all types of commodities.
   (a) Not, as popularly, supposed only in building materials, gravel, sand, brick and lumber.
2. Trucks carrying loads in excess of 25,000 lb. are overloaded per capacity 87.8 per cent of total number of loads.
   (a) Majority of overloads in excess of 25,000 lb. are trucks not capable of carrying 25,000-lb. load, or trucks whose rated capacity falls below 25,000-lb. load class.
3. Overloads occur with greatest frequency between 3.4-ton capacity trucks to and including the 5-ton truck, ranging from 20 per cent overload per capacity for 1-ton trucks to 62½ per cent overload for 3-ton trucks. The weighted average overload per capacity is 39 per cent.
4. Overloads occur on both front and rear axle. Since tires are built to carry rated capacity and wheel load recommended, the trucks are undertired when overloads occur on either axle.
5. Overloads on the rear axle, according to the manufacturer's weight distribution, and overloads on the rear axle in excess of 800 lb. per inch of tire width agree, indicating that both methods of analysis are correct. A considerable difference between front-axle weights, according to recommended axle load and load per inch of tire width, occurs. Overloads per inch of tire width, front axle, average 12 per cent and overloads per capacity, front axle, 40 per cent, indicating the manufacturer's recommended weight is incorrect and in excess of tiring for front wheels.
6. A direct relation exists between the width of truck body in excess of 7 ft. 6 in. and overloading per capacity.
7. A direct relation exists between overloads per capacity and overloads in excess of 800 lb. per inch of tire width, not only loads in excess of 25,000 lb., but in cases where the load is an overload per capacity.
8. Regular trucking lines are consistent overloaders. The overloads in excess of 25,000 lb. are 88.7 per cent regular trucking lines.

Recommendations—1. Classification of highways, depending on construction type, and designation of vehicle load permitted on both primary and secondary roads.
   (a) Such classification to be based on accurate information as to the effect on the highway of different loads.
2. Seasonal restrictions of vehicle loads; reduction of gross weight during spring seasons of year when possibilities of damage are high.
3. Prohibition of overloads beyond capacity of truck, restricting wheel load to 800 lb. per inch of tire width.
4. Maximum body width 7 ft. 6 in., projections from truck bodies to be included in maximum width.
5. Maximum total, front and rear-axle weights, to be determined by state highway commission for each make and classification of trucks; these data to be placed in conspicuous place on the vehicle; basis of overloads to be determined in each individual case.

Testing Concrete Material for Detroit Sewers

IN DETROIT until recently concrete aggregate for city work has been accepted with only a cursory examination, although all cements used in municipal work have been tested for many years. The Department of Sewer Construction, which is now engaged in an extensive program of construction, has recognized the importance of the quality of concrete aggregates, however, and has equipped a laboratory for the study of aggregate in charge of W. H. Dorrance, Jr.

A survey of local conditions revealed the fact that gravel used in city sewer work came from different localities. Some supply contractors furnished bank-run gravel from outlying pits, while others sold river sand. This naturally complicated the problem of inspection for it was to be expected that a wide range in quality should be found. In order definitely to establish this range and pave the way for future limitations in the specifications, three simple tests were decided upon. Since it was desired to keep the initial expense well within $100, these tests should of necessity require no elaborate apparatus. On the other hand, they must conform to recognized standards in order to be of any future value. The tests are: (1) The Abrams-Harder test for organic impurities; (2) the mechanical analysis of fine aggregates, and (3) the decantation test for silt. The organic test has been found entirely adequate in the detection of organic impurities. The analysis of aggregates under ¼ in. is made with a Universal sand tester. While the screens are not Tyler standard, they conform to the principle in that each sieve has an opening width double that of the preceding one. In this way a comparative modulus of fineness can be computed for each sample. It is admitted that the value of this analysis as a current means of regulation is nothing under the existing specifications. However, it is believed that it is the cheapest means of placing on record the mechanical structure of the concrete. Future specifications will undoubtedly place more stress on this heretofore neglected characteristic. The decantation test for silt is used in conjunction with the organic test; this is really a field test, but no means of performing a more exacting test were available.

The ordinary weekly routine is simple. An endeavor is made to cover each job at least once a week. Samples are taken from the material piles and prepared for the tests by passing through a ¼-in. screen. The calorimetric test is recorded after being allowed to stand at least two days, at which time an approximate silt percentage can be estimated. If this percentage is rather high the sample is set aside for an immediate decantation test. Once a month or oftener samples are put through the sand tested and sieve analysis curves plotted. Reports of all tests are made to the inspection department and the engineer at the end of the week.

Alumina Cement; Its Development, Use and Manufacture

History of and Properties of High Strength, Quick Setting Cement Now Being Produced Commercially in France

By Henry S. Spackman
Consulting Engineer, Philadelphia, Pa.

THE purpose of this paper is to make available to the American engineer, in the form of a digest, definite information relative to the alumina cements now commencing to be generally used in France. These cements are differentiated from portland cements by their chemical composition and by the fact that both in mortars and concretes they develop strength at the 48-hour period equal to, or exceeding, that developed by portland cement at 28 days. In addition, alumina cements show a markedly greater resistance to the attacks of sea water and water carrying sulphates in solution.

Owing to lack of space no detailed chemical discussion will be attempted and references to laboratory investigations will be confined to a brief résumé of conclusions drawn by the different investigators.

Early Study.—Almost twenty years ago the thought occurred to the writer that it might be possible to produce a better and more uniform cement than portland, and possibly a cheaper one, by the mechanical admixture of the separately prepared compounds then considered its essential components. With this object in view, the writer, at first in collaboration with Dr. E. W. Lazell, and subsequently with E. L. Conwell, had made and studied in his laboratory, the various silicates, aluminates and ferrates of lime then thought to be essentially present in portland cement together with a number of possible variants of these compounds, among which were aluminates of lime in proportions corresponding to two and three molecules of alumina to one of lime.

The purpose in making these various low lime aluminates was to ascertain the minimum amount of lime necessary to make the alumina active and cause it, on being added to lime, either in the form of oxide or hydrate, to combine with it.

Briefly summarized, the conclusions drawn in relation to aluminates from this investigation which covered a period of over ten years, were:

That cements resembling portland cement in their action could be made from mechanical admixtures but that these cements did not develop strengths comparable with the strengths developed by low lime calcium aluminates.

That where the lime present in the aluminates exceeded that required to form a mono-calcic aluminate, the aluminate was usually too quick setting for practical use as a cement.

That where the lime present approximated that required to form mono-calcic aluminates they could be made either slow or quick setting by varying the hardness of burning. The lighter burned aluminates were quick setting and the harder burned, slow setting.

That when the lime present was less than that required to form mono-calcic aluminate, the aluminate was slow setting.

That the quick setting mono- and di-calcic aluminates could be made slow setting by the mechanical admixture of slow setting low lime aluminates.

That both the slow setting low lime aluminates and the slow setting mechanical mixtures of quick setting and slow setting aluminates were slow setting but very quick hardening and developed strengths greatly in excess of portland cement, especially at short time periods. The 24-hour tests showed strengths exceeding those of portland cement at 28 days and that the lime content in the aluminates could be reduced as low as three molecules of alumina to one of lime without apparently affecting the cementing value of the product.

That other sesqui-oxides could be substituted for alumina and that the presence of sesqui-oxide of iron up to 10 per cent seemed beneficial.

That the presence of silica in any considerable proportions tended to reduce the early strength of aluminates, probably through replacement of the alumina content to which the high early strength was attributed.

That the cementing values and soundness of aluminates were apparently unaffected by wide variation in the ratio of the lime to acid acting elements provided the lime was not present in excess of that required to form mono-calcic aluminates.

That these alumina cements were strongly resistant to dilute acids and unaffected by sea water. The very low lime aluminates interposed greater resistance to attack by acid solutions than the higher lime ones.

It was also found that these aluminates, in addition, had the property of combining with hydrated lime and that their addition gave to lime mortars quick hardening properties and plasticity and that relatively small additions of these aluminates greatly increased the early strength and natural and puzzolanic cements.

Attempts at Development.—As the purpose of the research was strictly commercial, no attempt was made to obtain even relatively pure materials but on the contrary low grade bauxites that could be cheaply secured in the market were used.

The equipment of the laboratory did not permit of such research work as was subsequently carried out by Day and Sheppard, Rankin, Bates and others, consequently no attempt was made to determine the chemical compounds formed in the various aluminates produced.

During the first years of the investigation, the aluminates were produced in the laboratory either by calcination in a small kiln 12 in. in diameter and 3 ft. high, or were fused in graphite crucibles heated in a gas-fired reverberatory furnace. Subsequently aluminates were produced on a semi-commercial scale in a kiln 3 ft. in diameter and 10 ft. high. Both kilns were operated continuously. The raw materials after being ground, moistened, and molded into small bricks and dried, was fed into the kiln with the fuel and the calcined material was drawn from the bottom. In all, some 20 tons of slow setting, quick hardening alumina cement was manufactured.

In 1909 the Aluminate Patents Co. was formed for the commercial development of the patents granted the writer, but as the writer's patents covering the alumina cements had been held up by interference proceedings between his application and M. Bied's, which interference was subsequently decided in the writer's favor, and as the use of alumina cements as an addition material to lime seemed the most promising of immediate financial return, no effort was made to place the low

lime alumina cements on the market nor was any description of them published at that time.

As the aluminates made from mixtures of lime and bauxite in the manner described above, were very expensive, there was substituted for them, a high alumina slag produced by the Pennsylvania Steel Co. from the smelting of the Mayari ores of Cuba which gave slags low in silica and having an alumina content of about 30 per cent. While this slag in itself, was an inert material, it could be made by special treatment sufficiently active to combine with lime and serve as an additional material.

The writer regrets that his test of the high alumina cements were confined to tensile and compression tests of the cements either neat or 1:3 sand mortar. His explanation for this omission is that the importance of concrete tests was not recognized at the time.

Early French Investigations.—Jules Bied, Director of the Laboratories of J. & A. Pavin Lafarge, le Teil, France, began some time previous to 1908 a study of calcium aluminates which covered much the same ground as the writer's work and led to the same conclusions except that Bied concluded that the fusion of the bauxite and lime mixture was essential to the production of cement and that he failed to note the value of aluminates as addition material to lime or other low grade cementitious materials. The work of Bied, therefore, was confined exclusively to determining the value of the low lime aluminates for use as a cement. His work showed not only the high strengths at early periods of fused mono-calcic aluminates, but also the continuance of the strength so developed over long periods and also the resistance of these cements to the destructive action of sea water and water carrying solution sulphates of the alkaline earths.

As a result of Bied's laboratory investigations, the firm of J. & A. Pavin Lafarge commenced about 1912 to place fused mono-calcic aluminate cements on the market under the trade name of "Cement Fondu." The outbreak of the war stopped the commercial development of these cements but their manufacture was continued for military use.

Corroborating Investigation.—P. H. Bates of the Bureau of Standards (see Technologic Paper 197) has recently reported results of a very extended study of aluminates undertaken by the Bureau of Standards under his direction. This research included the microscopic determination of the compounds formed both by the calcination and hydration of the aluminates as well as physical tests of neat, mortar, and concrete specimens made from eight different lots of alumina cements of varying compositions produced by calcination in the rotary kiln.

His conclusions in general correspond with those of Bied and the writer. He found that the higher lime aluminates were quick setting and that the lower lime aluminates were slow setting and that the hydration of the lower lime aluminates consisted in the formation of hydrocalcic aluminate and hydrous alumina. He found that the low lime aluminates gave high strength at short periods, the rapid hardening being due to the rapidity with which the aluminates hydrated and the high strengths due to the thoroughness of the hydration and the large amount of colloids formed, but, that owing to the susceptibility of these colloids to moisture changes, the alumina cements would not be satisfactory for use when subject to the action of water.

Laboratory Conclusions.—The work of these three independent investigators demonstrates beyond all possible question the fact that slow setting, quick hardening cements can be produced by the calcination of mixtures of alumina and lime in which the ratio of available lime to alumina does not exceed the monocalcic proportion: that the cement so produced gives strengths, neat, in cement mortars, and in concretes, at the end of 24 and 48 hours as high or higher than the strengths ordinarily developed by portland cement at 7 and 28 days and that the strengths of low lime high alumina cements continue to gain up to the three month period. So far the conclusions drawn by the three investigators from their work are in complete accord. Mr. Bates also states "that the methods of storage of the test pieces showed that these cements had their strengths rather materially reduced by the absorption of moisture. This was due to the large amount of colloidal products of hydration which are very susceptible to moisture changes. They would, therefore, not be satisfactory for use when subjected to the action of water." This action noted by Mr. Bates is not in accord with the experiences of M. Bied and the writer in their laboratory work nor with the results obtained by actual use in work in France of such cements extending through a period of over ten years. This difference on so vital a point is unfortunate and it is to be hoped that continuance of the tests and further analysis of the results will lead Mr. Bates to a modification of his conclusions which, however, applies only to the particular cements made by the Bureau of Standards tested under the methods employed.

So far as indicated by his reports, the resistance of the high alumina cements to the destructive action of sea water and water containing sulphate solutions was not noted or studied by Mr. Bates.

Present Use in France.—With the end of the war, high alumina cements were again placed on the French market. At present two firms are engaged in their manufacture and sale, J. & A. Pavin Lafarge and the Bureau D'Organisation Economique. When the writer was last at the works of Lafarge in 1919, alumina cements were being produced in a small furnace, the coke, limestone and bauxite being fed into the furnace without preliminary fine grinding. The molten material was drawn from the furnace in the same manner as slag from an ordinary blast furnace. The iron oxides contained in the raw material, owing to the reducing action of the furnace and difference in specific gravity, partially separated out from the slag as metallic iron, but not sufficiently to affect the color. All commercial alumina cements are much darker in color than portland cement. If bauxite low in iron is used, a white cement can be produced. Lafarge markets his cement under the trade name of "Cement Fondu." This company is now constructing a second plant at Moutiers, Savoie, France, where the electric furnace will be used. The alumina cement produced by the Bureau d'Organisation Economique is fused in an electric furnace, hence its trade name, "Cement Electric."

Properties of French Cement.—In a recent letter, the Bureau D'Organisation Economique makes the following claims for "Cement Electric":

The cement is a mono-calcic aluminate containing a fixed quantity of silica and oxide of iron and is made by the grinding of a product produced by the fusion in an electric furnace of a predetermined mixture of silica, alumina, iron and lime. The finished product is a mono-calcic aluminate containing certain quantities of silica and oxides of iron.

The cement is slow setting and is gaged like the ordinary portland cements but is distinguished from them by the altogether special qualities that it hardens rapidly and gives high strengths at early periods and is indecomposable by selenious waters and sea water.

It is used in the same manner as portland cement but hardens more rapidly.

It is no exaggeration to say that at the end of 24 hours its strength equals that of portland cement at the end of a month, therefore, forms may be removed from walls after 24 hours and from girders and slabs after 48 hours. Concretes mixed 1 part cement, 1 part sand, and 3 parts gravel show compressive strengths of 7,500 lb. per square inch at the end of 3 days, 8,500 lb. at the end of 28 days and 9,000 lb. at the end of 3 months and continue to show slowly increasing strength with time. Concretes mixed in the proportions of 1 cement, 1½ sand, and 3 gravel, give strengths of 5,750 lb. at 2 days, 6,000 lb. at 7 days, 7,500 lb. at 28 days and 7,750 lb. at 3 months. Therefore, in making calculations for structures, the compression members may be figured at 2,000 lb. per square inch instead of at 700 lb. generally used for portland cement. This results in a marked diminution in the section of compression members which together with the saving in form lumber, offsets the higher price of the cement.

The writer has no recent figures covering the strengths developed by the "Cement Fondu" but from information obtained in 1919 believes there is little or no difference in the strengths developed by the two cements.

Owing to the higher price, the use of alumina cements in France to date has been confined to work where the special qualities are more important than price, such as repairs of streets and pavements, floors of factories, urgent alterations, foundations for machinery, etc., and in work exposed to water carrying injurious solutions and to special construction of which the following are typical examples:

Structural Uses.—In the construction of a large coal storage depot for the Compagnie du Nord it was found that the foundations must be carried through a thick layer of quicksand and sunk to a depth of about 25 ft. The quickest and most economical method of sinking the foundation was by the use of caissons. This method was adopted, but with this novelty, the caissons which were constructed of alumina cement were also the outside foundation walls. The largest of these had exterior dimensions of about 85 ft. in length and 25 ft. in width with a height of about 25 ft. This caisson, in addition to serving as a foundation for the coal storage bins mentioned above, was to be used as a room for the installation of power plant and coal handling machinery. Sinking the caisson, which was loaded with 225 tons in addition to its own weight, was started immediately after pouring. By reason of the unequal resistance of the soil during the descent, this caisson at times was very apparently deformed but never cracked or fissured and after being finally set in place there was absolutely no permanent deformation.

In another case it was desired to remodel a five-story building, the three upper floors of which were occupied as apartments and the two lower floors as offices of a bank. The work involved the removal of a maze of small rooms, the walls of which, as is customary in France, were masonry and carried the upper stories so as to form the large halls and offices of a modern bank. This reconstruction had to be done without interruption to the work of the employees in the bank in the two lower floors and without inconvenience in any way to the occupants of the three upper floors. Steel beams and columns could not be used as it would be impossible to put them in place without interfering with the occupancy of the building. Ordinary reinforced concrete was also objectionable as it would have required leaving the forms and supports in place for two or three weeks. It was, therefore, decided to use concrete of alumina cement. This was found very satisfactory as the forms and supports could be removed within 48 hours. In addition, a considerable saving in cost resulted as compared with portland cement through the use of smaller sections, a reduced quantity of form lumber and time required for the work.

Commercial Possibilities.—As made in the laboratories of Bates and the writer, the manufacture of alumina cement differed in no way from the customary processes employed in the manufacture of portland cement and any portland cement mill could produce alumina cements from a mixture of bauxite and lime without change of machinery.

Omitting the price paid for the bauxite, the cost of manufacture, provided the aluminates did not materially reduce the production of the kiln through excessive ringing up, should be no greater than for portland cement. Theoretically it should be somewhat less as, owing to the low lime content and consequent reduced loss on ignition, a less quantity of raw material would have to be handled and in addition there should be some saving in the fuel required.

The use of the dry process, however in connection with so high priced a raw material as mixture of bauxite and lime, would not be economical owing to the dust losses and these should be minimized by the use of the wet process. It is probable that this dust loss together with the tendency to ringing up in the kilns of the lime-bauxite mix, was what induced the Bureau D'Organisation Economique to adopt the electric furnace, for in 1919 M. Bied told the writer that as a result of his discussion with him in 1917 he had repeated his experimental work and found that fusion of the alumina cement was not necessary. Therefore, in the design of the new plant he expected to use the rotary kilns.

At present cost of fuel in France there is no marked economy in the use of the electric furnace, for while the number of kilowatt hours required to fuse a ton of cement is relatively low, this economy is offset by the high consumption of electrodes the cost of which offsets any fuel economy due to the use of hydro-electric power.

The increased cost of alumina cements produced in this country over portland cement will, therefore, be dependent on the price paid for bauxite. Assuming a price of from $12 to $15 a ton for bauxite delivered at the works, this increased cost would amount to from $1.50 to $2 per barrel which should permit of the alumina cements being manufactured and sold at a price

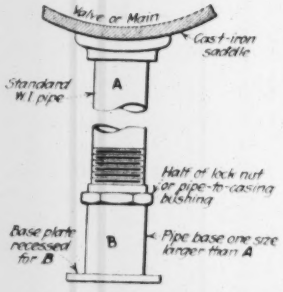
of about $4.25 per bbl. f.o.b. works, exclusive of package, which price corresponds to that at which it is now being sold in France. If, however, there was substituted for the better grade bauxite suitable for chemical work, bauxites high in iron, or there was substituted for part of the bauxite high alumina slags such as those produced by the Pennsylvania Steel Co. where the alumina content ran from 28 per cent to 32 per cent and the lime from 28 per cent to 30 per cent, or some other waste material high in alumina, a very marked saving should be made in the costs of these cements. Furthermore, the cost of the high grade bauxites would be much lower for mills located near the deposits as the price of bauxite used was f.o.b. Philadelphia.

While at first thought the use of a cement costing two or three times that of portland cement would seem prohibitive, the saving in time and form lumber will to some extent offset this and still further saving would be made, if as claimed by the French, a material reduction in section can also be made and still give a stronger structure.

Convenient Means of Supporting Mains or Valves in Pumping Plant

A convenient means of supporting the weight of water mains or valves in a pumping plant being used in the new plant at Sacramento, Cal., consists chiefly of a pipe of suitable size and length, as shown in the accompanying illustration.

The saddle on which the valve or main is to be supported is an iron casting on the underside of which is a circular groove to fit the pipe *A*. The latter sets loosely in *B*, which is a size larger than *A*, and the weight carried by *A* is transmitted to *B* by means of one-half of a lock nut or a pipe-to-casing bushing. The latter gives a more workmanlike appearance, but before being suited to this purpose its lower end has to be cut off in a lathe and the threading for the pipe *A* run clear through. The bottom of pipe *A* has a long thread for adjustment. When ready for service the bushing is turned until pipe *A* thrusts the saddle up snugly against the weight above it and takes the desired amount of load. The base plate is recessed with a circular groove to take the pipe *B*. When the exact location is known in advance a neater job is obtained by imbedding the base plate in the concrete. If installed later the plate can be set on top of the finished floor.



CONVENIENT SUPPORT FOR MAINS HAS ADJUSTABLE FEATURE

Lining Tunnels Under Traffic

Plant and methods employed in lining a number of railway tunnels without interrupting traffic are described in a 45-page report in the 1921 proceedings of the American Railway Bridge & Building Association (Secretary, C. A. Lichy, Chicago). The lining in most cases was concrete placed by hand or by the pneumatic method, but in one case cast-iron segments were used.

Window Protection Recognized as a Serious Fire Problem

Round-Table Discussion of Fire Protection Based on Burlington Fire—Water Spray and Outside Shutters

SINCE the destruction of the Chicago, Burlington & Quincy Ry. offices in the Chicago fire of March 15, with its demonstration of the vulnerability of office buildings to outside fire attack, concern has been felt by building owners and insurance men over the obvious necessity of providing such buildings with more effective window protection than is now in use. The National Fire Protection Association therefore arranged a discussion of window protection against exposure fires at its annual meeting at Atlantic City on May 10. Active exchange of views developed in this discussion, with the main result of showing that the problem affects large numbers of important buildings, that the reliance upon street-width separation of buildings for protection is unwarranted, and that means for protecting window openings require much further study.

Mathews Describes Burlington Fire—W. D. Mathews, of the Chicago Board of Fire Underwriters, opened the discussion with a description of the Burlington building fire (see *Engineering News-Record*, March 23, page 495). According to his description, the fire from burning buildings to the eastward crossed the 80-ft. width of Clinton St. very rapidly. After it entered the building, the heat produced by combustion of the contents of the building itself was the determining factor in the destruction produced; the heat effects were considerably more severe at the windows on the west and south sides of the building than on the north and east, where fire originally entered.

Except for what was in the vaults the contents of the building were entirely destroyed from the ninth to the fifteenth floors. The contents of the vaults were not harmed, even a feather duster in one of the vaults being found uninjured. The vault walls were of 6 in. of reinforced concrete and 3-in. tile facings inside and outside, and were equipped with double doors. The outer doors warped, but the inner doors remained tight enough to keep out the heat. The enclosure containing the stairs was not penetrated by the fire, and in fact remained accessible throughout the fire; one of the fire officials remained in the stair shaft during most of the fire. The fact that there was no standpipe in this shaft greatly reduced the means for fighting the fire.

Question being raised as to whether the fire was transmitted to the Burlington building by direct flame or by heat radiation, Mr. Mathews expressed the opinion that radiation was probably not the cause. Others, however, held that radiation was responsible, and cited other instances of very strong transmission of radiated heat. In particular A. R. Small, of the Underwriters' Laboratories, reported experiments on transmission through windows which demonstrated a strong transmission effect.

Mr. Small characterized the Burlington fire as equivalent to a 1- to 1½-hour test, judging by the effect on the terra cotta exterior of the exposed walls. Had the fire been longer it would probably have done damage to the contents of the vaults and the performance of the vaults in the actual fire should therefore not be given too much weight. He expressed the opinion that

a north-south cut-off wall through the building would have saved the western half. The resistance of the wire glass in the elevator enclosure was favored, Mr. Small believes, by the fact that the lights were of small size which, as shown by tests, have much greater resistance than large lights.

Windows Need Wire Glass Plus Something—Ira H. Woolson, consulting engineer of the National Board of fire Underwriters, called the Burlington fire the most important demonstration in recent years of the need for better window protection in high-grade office buildings. For years the National Board has advocated wire glass for windows separated by a horizontal distance of 50 ft. or less from other buildings, and in any case above 75 ft. height. Of a large number of cities to which this clause was recommended, in the revision of building codes, only 17 per cent accepted it, 30 per cent ignored it and the others adopted less severe provisions, as, for instance, a 30- to 35-ft. exposure width. But the Burlington fire demonstrates that the Underwriters' own recommendation is not drastic enough.

Mr. Woolson concludes that windows in office buildings should be protected by wire glass plus something. What that something is cannot yet be told. The choice so far as known at present lies between inside and outside shutters, a water curtain, spray from an outside sprinkler directed on the window, and inside sprinklers. The protection of window openings is one of the big questions before the public today. Glass alone is not sufficient.

Outside Shutters Regarded Favorably—Mr. Woolson expressed the opinion that on present showing an outside shutter affords the best possibility for window protection. An automatic rolling shutter such as used by the American Telephone & Telegraph Co. seems the best available device. D. K. Boyd, architect, Philadelphia, disagreed with this view, and stated that shutters are difficult in application and esthetically objectionable, so that a water sheet or curtain appears the more desirable solution.

Water Curtain and Sprays—Favorable testimony concerning water sprays directed against the outside of windows by outside sprinklers was given by several. A. R. Small reported experiments at the Underwriters' Laboratories in which a hose stream directed on a glass window in a test partition very greatly reduced the transmission through the window of heat from a fire built on one side. A water curtain 15 in. away from the window did not stop the radiation in the same degree. A steel shutter stopped more radiation than the plain glass window; a wood-filled door stopped much more heat than either.

In the case of a fire in Worcester, in January, 1921, cited by R. S. Moulton, assistant secretary of the association, outside sprinklers protected a building 30 ft. from a fire. J. J. Conway, superintendent of the Salvage Corps, Cincinnati, instanced a case where a water curtain held a 10-story building face against a severe fire exposure on an 80-ft. street. The windows in this building face were plain glass in wooden frames, and remained undamaged after the curtain or spray got into action, although wire glass 400 ft. distant from the fire was cracked. He warned against the danger of failure of such protection through insufficient water, however. Lack of water is a common cause of sprinkler failures, and in this particular service the requirement is to supply sufficient water for all the heads that may open from simultaneous exposure of many floors to radiant heat.

On this particular point, H. P. Weaver stated that if all the windows in the north and east faces of the Burlington building had been equipped with outside sprinklers, a supply of about 8,000 gallons per minute would have been required to feed them. In general, outside sprinklers on a large building might require from 4,000 to 10,000 gallons per minute throughout a two-hour period. Present supply systems do not make such volumes of water available.

Inside Sprinklers—One case of effective protection through inside sprinklers was instanced by J. H. Brumbaugh. In a fireworks building fire in Chicago six or eight years ago, a building 12 or 14 stories high was exposed. The firemen who entered this building at once knocked open the line of sprinklers nearest the windows on each floor, with the result that the contents of the building were protected although the bricks on the outside of the wall spalled.

Question To Be Investigated—On motion of W. H. Merrill, of the Underwriters' Laboratories, the question of window protection was referred to the executive committee of the association for inquiry through a questionnaire by which information and experiences are to be collected. If the results of the inquiry warrant, the subject may then be referred to a special committee for study.

Herbert Hoover on a Plan for New York and Its Environs

Substance of an address before a meeting at the Engineering Societies' Building, New York City, May 10. See News columns for details of the meeting.

THE action of the Trustees of the Russell Sage Foundation in providing for a survey of New York City and its environs by engineers and other experts and for the preparation of a comprehensive plan for the development of the entire district deserve the highest commendation.

The enormous losses in human happiness and in money which have resulted from lack of city plans taking into account the conditions of modern life, need no comment. The lack of adequate open spaces, of playgrounds and parks, the congestion of streets, the misery of tenement life and its repercussions upon each new generation, are an untold charge against our American life. Our cities do not produce their full contribution to the sinews of American life and national character. The moral and social issues can only be met by a new conception of city building.

The great growth of industry since New York was originally planned presents a host of new problems. The cost of distribution of necessities within the boundaries of the city increases each year. The inadequate system of transportation terminals and commodity distribution taxes New York 10 or 15 per cent upon the cost of living above more adequately served centers.

Many of our industries are seasonal. If we are to secure high living standards and to gain in national productivity, these industries must be so interlocked as to give more continuous employment. The fact that New York has at all times the largest proportion of unemployment of any of our cities is due partially to this ill adjustment.

New York is the gateway of Europe into the United

States and the dumping of great hordes of people into our slums is a poor introduction to Americanization.

One part of such a regional plan as is proposed must be to bring home to each economic group in the district a full realization of its function in the great whole of which it is a part. With this understood, residential districts whose interests center largely around low cost of living and educational and recreational facilities would insist on better means of distribution of commodities and of the development of public utilities. The manufacturing districts would demand not only better aligned transportation but also co-ordination of manufacturing to residential areas along human lines. Manhattan in particular needs today not more centralization but decentralization.

The vision of New York and its environs as a well planned location of millions of happy homes and a better working center of millions of men and women grasps the imagination. A definite plan for its accomplishment may be only an ideal. But a people without ideals degenerates; one with practical ideals is already upon the road to attain them.

Long Colorado Railway Tunnel to Be Built by Improvement Bonds

RAISING funds for the construction of a railway tunnel by the organization of an assessment or improvement district authorized to issue bonds, on the same general basis as an irrigation or drainage district, is an innovation which has been made practicable by the recent passage of a State law in Colorado providing for the Moffat tunnel improvement district on the line of the Denver & Salt Lake R. R.

Development of the territory served by this railway, its traffic facilities and its economy of operation are all hampered by the present open line over the range with grades of 4 per cent and a summit elevation of 11,660 ft. Financial assistance in extending the railway through a productive district in order to complete a new link in a transcontinental route hinges largely upon the construction of this tunnel in order to remove the present operating handicaps. But the railway company, in which Denver industries have a large interest, is unable to finance this desirable work.

In view of this situation and the potential advantages of a favorable line in relation to the commerce and development of Denver and the State of Colorado there has been a strong movement for the undertaking of the tunnel as a public work. The first plan was to issue State bonds to raise funds for the Moffat tunnel and two tunnels on other routes, but this project was defeated by public vote (see *Engineering News-Record* of April 8, July 1 and Dec. 30, 1920, pp. 716, 44, and 1302). The next plan was to organize a tunnel district in which assessments for benefits would be levied. This plan has been made practicable by the passage of the bill noted above.

The tunnel bill provides for the formation of the Moffat Tunnel Improvement District by means of which bonds may be floated for constructing a tunnel through James Peak at a cost not to exceed $6,720,000. The district, which will be contiguous to the railway in Denver, Adams, Jefferson, Boulder, Gilpin and Moffat counties, will include territory directly benefited by the tunnel. All real estate exclusive of improvements will be assessed, levies will be paid as taxes, and bonds will be issued at not exceeding 6 per cent to cover the cost. Rights of protest and appeal are allowed, consent of owners of 50 per cent of the property being required to make the bond issue legal.

Both the financing and construction are to be directly under the control of a commission composed of five members appointed by the governor. The law provides for the use of the tunnel for other than railway purposes, including the carrying of water for the future use of the city of Denver. Surveys indicate a tunnel about six miles long with a summit elevation of 9,100 ft. and having approaches with grades not exceeding 2 per cent and curvature not exceeding 10 degrees.

Determining the Penetration of Wood Preservatives

THE effectiveness of any wood-preservation treatment is measured very largely by the depth to which the preservative penetrates. This can be determined by the following tests used by the Forest Products Laboratory.

The presence of creosote oil is indicated by the dark discoloration. The degree of penetration may readily be determined by taking a sample at a point free from checks and other imperfections and at a considerable distance from the end. The sampling may be done either with an ordinary ½-in. bit, or with an increment borer which brings out a core of wood that shows in cross-section the depth of penetration. The observation should be made at once because the oil spreads rapidly over the cut surface. To prevent infection the hole in the treated piece should be tightly closed with a creosoted plug.

As zinc chloride is colorless the depth of penetration of this preservative must be ascertained by chemical means. After cutting the stick in half or getting a sample with the increment borer, the freshly-cut surface is dipped for not to exceed 10 sec. in a 1 per cent solution of potassium ferrocyanide and the excess solution is removed by blotting paper. The sample is then dipped into a 1 per cent solution of uranium acetate and dried. The treated portions will be whiter than the natural wood and those untreated will have a dark red or a maroon color. This method does not give sharp contrasts on wood which is reddish in color like red oak, but otherwise it is satisfactory and affords a permanent record.

Another method, developed by Galen Wood, consists in spraying over the freshly-cut surface a mixture of equal parts of a 1-per cent potassium-ferrocyanide solution, a 1-per cent potassium-iodide solution and a 5-per cent solution of soluble starch. This colors the treated portion a very dark blue but does not affect the untreated wood. Although the color fades in time it may be brought back by spraying again.

Sodium fluoride is colorless; no satisfactory method of showing its presence in wood has been devised.

Mercuric chloride is also colorless but dipping the wood in a solution of hydrogen sulphide turns the treated area black.

As individual pieces may show an abnormally high or low degree of penetration, a sufficient number of tests should be made to obtain a fair average. Samples should be taken at a considerable distance from the ends of the stick, in order that they will not be affected by the heavy longitudinal penetration.

ENGINEERING LITERATURE

Office Circulation of New Literature

Sir—I have read with much interest Miss Canavan's article on "Office Circulation of New Literature," in your issue of Feb. 16, p. 288. At Stone & Webster's Boston office library the system is similar to the one described by Miss Canavan, but the following objections have been raised by one of the members of our staff: (1) If in a hurry for a particular issue there is some delay in running a copy down. (2) The magazine, moving in an automatic way, has sometimes gone to the 'grave yard.' For instance, copy is delivered to Mr. Smith, who is away for a few weeks, and in that case Mr. Jones will receive it at a later date when it has lost its value to some extent. G. W. LEE,

Librarian, Stone & Webster, Inc.

Boston, Mass., March 20.

"Human Engineering"

Sir—As a result of the war, many men are wondering if humanity is on the right track and if the human race is really achieving its destined place in the scheme of things. Alfred Korzybski, in "Manhood of Humanity, The Science and Art of Human Engineering" (E. P. Dutton & Co., New York City; $3), asserts that man is not developing as he should because he is not living in accord with the laws of human nature. He presents a new concept of man based upon his supreme faculty of appropriating and using the fruits of the labors and experiences of past generations as intellectual and spiritual capital for development in the present, and the capacity of conducting his life in the ever increasing light of inherited wisdom. By reason of this faculty, man's development is not subject to the laws that apply to animals, but is nevertheless governed by natural laws, the laws of human nature. It is man's chief duty to his race to discover the laws of human nature and teach his fellow beings to observe and live in accord with those laws. Then will humanity emerge from its infancy and attain its manhood. Human Engineering is defined as "the science of Human Nature and the Art of directing the energies and capacities of human beings in accordance with the laws of Human Nature for the advancement of Human Weal."

The book is carefully written in simple, precise language. The arguments are based upon a wide range of historical facts and the conclusions are supported by mathematical deductions which leave the reader with the conviction that the author has presented new ideas of man and his destiny which are convincing and deserve careful consideration.

Engineers, both by their training and method of thought, are perhaps the best qualified to discover and prove the laws of human nature, and, when discovered, help to apply them for the advancement of the human good. Surely there can be no more noble task for engineers than to engage their talents and labors in this human problem which the author calls the Science of Human Engineering.

Harriman, Pa., Feb. 20. WILSON FITCH SMITH.

Modern Roads from French Point of View

LES CHAUSSÉES MODERNES—Par P. LeGavrian, Ingénieur en Chef des Ponts et Chaussées. Paris: J. B. Bailliere et Fils. Paper: 6 x 9 in., pp. 431; half tones and line cuts. Paper, 40 fr.; flexible binding, 50 fr.

Happily, the author of this book avoids that tedious recital of road building history, beginning with the practice current among the ancient Romans, with which so many American and British authors feel it necessary to preface any text on the general subject of highways. Instead, he starts with a statement of the pressing problems of to-day, due to changes in the character and volume of traffic. The technique of highway practice has undergone so many changes within the past few years in order to cope with the needs of increased motor transport that most of the former standard texts in French are inadequate. Some of the newer American and English books have more nearly kept pace with recent progress, but none of these has been translated into French. In bringing together into one volume a statement of methods, materials and machinery used by road builders of today, M. LeGavrian has performed a real service, not only for his compatriots but for engineers of other countries who are able to read French.

For a task of this sort the author is particularly well qualified. In his several capacities as *ingenieur en chef des Ponts et Chaussées*, professor at the *Ecole Nationale des Ponts et Chaussées*, and secretary of the Permanent International Association of Road Congresses, he has had unusual facilities for the preparation of a comprehensive and authoritative text on modern road building. The book consists, in part, of material which M. LeGavrian used in lectures to students at the *École Nationale*.

The book is divided into two parts, the first dealing with bituminous materials—their nomenclature, methods of production and physical and chemical properties and tests—and the second with the design and construction of the several standard types of paving surface, including bituminous, concrete and block pavements.

In French and British practice engineers have devoted far more attention to roads of bituminous types than to concrete pavements. This trend is clearly reflected in the book, 215 pages of which are devoted to tar and asphalt types, while only 30 pages deal with concrete. There is an extensive treatment of the nomenclature of tars, bitumens, asphalts and their derivatives with detailed reference to American, German, British and French terminology. M. LeGavrian deplores the confusion created by the classification of the same materials, in different countries, under different names.

The second and third chapters are devoted to the methods of production and specifications for bituminous binders and to methods of testing the physical and chemical properties of these materials. There follow several chapters on methods and materials employed in penetration and in mixed bituminous con-

struction, together with notes on distributing apparatus, mostly French and English. In these types of work the instructions of the British Road Board are are extensively quoted.

One of the most interesting chapters is the one dealing with the formation of "waves" in bituminous surfaces. One of the chief causes emphasized by M. LeGavrian is faulty rolling and he illustrates a three-wheel tandem roller, designed by Col. Crompton, a British engineer, to eliminate the formation of waves during construction. The author lays great stress upon the importance of proper methods of compression in bituminous pavement construction to prevent waves.

The chapter on concrete roads, particularly that part of it dealing with construction methods and machinery, makes frequent reference to American practice, although it is evident that French engineers are not yet prepared to accept the concrete road with the same degree of confidence as do their American confreres. This opinion is reflected on p. 253 of the text where the author states that French engineers are still of the belief that the concrete pavement possesses insufficient elasticity to resist economically for any length of time heavy traffic even though it be not intensive. Nevertheless, reference is made to the conception of the concrete road as not necessarily a permanent surfacing, but rather as a means of carrying traffic until its condition becomes such as to require some form of covering, such as an asphaltic top. Comparatively little space is devoted to reinforced-concrete roads. In American practice, at least, there is a distinct trend toward reinforcement on trunk-line routes and even in those states where a considerable yardage of this type has been built heavier reinforcement than has been adopted in the past is common.

The final portion of the book deals briefly with block pavements, including wood, brick, asphalt block and stone mosaic. On these types the author mentions only the outstanding features and avoids entirely the matter of detail, either in design or construction.

An exceedingly valuable portion of the book is the dictionary of road-building terms which forms the first appendix. Here one may find a concise definition for example, of the types of pavement, called "Ferromac" or "Gladwell" and other special terms or patented types of construction. The volumes concludes with quotations from French ministerial instructions on paving methods and materials, and specifications approved in 1915 by the Direction Administrative des Travaux of the city of Paris.

Novel in Its Method of Approach

REVIEWED BY LEWIS E. MOORE
Consulting Engineer, Boston, Mass.

ESSENTIALS IN THE THEORY OF FRAMED STRUCTURES —By Charles A. Ellis, A.B., Vice-President, The Strauss Bascule Bridge Co.; with American Bridge Company 1901-1908; Assistant Professor of Civil Engineering, University of Michigan, 1908-12; Designing Engineer, Dominion Bridge Co., 1912-14; Professor of Structural Engineering, University of Illinois, 1914-21. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 330; illustrated. $3.50.

The author has produced a textbook which is quite novel in its method of approaching the subject and which should prove very useful because its aim is to develop the student's ability to think and reason rather than to produce either a good draftsman or a finished designer. In his endeavor to educate rather than instruct, as stated in the preface, the author has presented his subject in what he conceives to be the most natural sequence for the human intellect to grasp, i.e., illustrative problems are shown first, from which the underlying principles and formulas are deduced.

When it came to actually writing the book, the author evidently did not always find it possible to use this method, particularly not in the case of the chapter on the deflection of beams, but the method has been followed as closely as appears to be practicable.

The first chapter deals with the fundamental mechanics of the subject, taking up the equilibrium of co-planar forces, beginning with the parallelogram of forces and using both algebraic and graphic methods. It would seem that the treatment of the equilibrium of forces could have been improved by laying much more emphasis upon that most useful of mechanical concepts, the free body diagram.

The next chapter carries the application of the principles of equilibrium; as for the determination of the stresses in trusses, and discusses external and internal forces and the conditions of stability and redundancy. The usual methods of joints and of sections are illustrated and discussed. Beams come next. Graphical methods are first used to determine bending moments and later the ordinary forms of shear and bending moment diagrams are given. The method of distinguishing between positive and negative moments is stated in such a way that it would appear to the student to be a purely mathematical concept. It would seem that the author here missed an opportunity to give the mechanical concept that positive moment occurs with compression in the top fiber and negative moment with tension in the top fiber. Some attention is given to the development of the parabola in view of its importance in engineering diagrams. The chapter closes with illustrations of frames having members which act as beams, such as cranes, portal frames, etc., and gives the usual assumptions with regard to horizontal reactions and points of contraflexure.

The third chapter deals with roof trusses and pays careful attention to the uncertainties surrounding the design and to the assumptions which are made and the reasons for them. The author makes the point that the assumption of equal horizontal reactions in mill building bents is incorrect and gives a table based on accurate analysis made strictly in accordance with the elastic theory of structures. This table should be useful to the practical designer within the limits for which it is deduced. The author points out that it is in many cases unnecessary to make a stress diagram for wind only and that the uncertainties as to the values of wind pressure are such that a sufficiently accurate analysis can be made from vertical loads. Special consideration is given to columns and knee braces and to the web members which meet the knee braces. The author points out that there is no generally accepted standard specification for buildings in America and that as a matter of fact design is quite largely a matter of opinion with each designer. There is no standard type and so there are great difficulties in the way of a strictly scientific solution or analysis which will be of wide applicability without being exceedingly cumbrous.

Chapter IV deals with bridges, more particularly trusses, and begins by finding maximum stresses by means of influence lines, later bringing out the criteria for loadings which will produce maximum moment and shear. The subject is extended to cover curved-chord, as well as parallel-chord trusses.

The chapter on the deflection of beams is worthy of careful reading and study. The author has compressed into thirty pages much valuable information and gives the first complete demonstration of the area-moment method of handling the question of deflections that the reviewer has seen in an American text. This method is so simple in its application, and so quick in its results, as compared with the cumbrous integration of the second differential coefficient of the elastic curve, that it should be thoroughly understood by every engineer who has occasion to find deflections of beams. It is given with sufficient illustrations so that careful study will make its application in almost any case obvious. The chapter concludes with a statement of Maxwell's theorem of reciprocal displacements.

Restrained and continuous beams are next treated, using the area-moment method throughout. In the latter part of the chapter the theorem of three moments is briefly presented. The subject of partially continuous beams and continuous beams in foundations closes the chapter. The latter subject illustrates the errors made in common practice in designing continuous grillage beams in a foundation. The next chapter deals briefly with deflection of trusses, using both the method of least work and the Williot diagram. In the final chapter, on swing bridges, a short method of determining stresses in swing span trusses is given.

Finally, and writing as one who has had a number of years' teaching experience himself, the reviewer has long felt that the teaching of engineering is becoming too much a matter of deducing formulas and teaching facts, and too little a development of the philosophical side of the subject taught and of the student's power to think. A book of this type, which emphasizes the philosophical and imaginative side, should be welcomed, more especially by the mature and experienced teacher, and should prove very valuable in his hands. Whether it will prove as useful in the hands of a young teacher may, perhaps, be questionable, but in any case it is certainly a step in the right direction.

Information on Mexico for Americans

MEXICAN YEAR BOOK, 1920-1921—By Robert Glass Cleland, Ph.D. Los Angeles: Mexican Year Book Publishing Co. Cloth; 6 x 9 in.; pp. 524. $7.50.

The editor of this Year Book anounces that his purpose is to meet the demand for unbiased and systematized information concerning Mexico, prepared to suit American needs and having no official Mexican patronage. The subject is considered under seven heads: History and Geography; Politics and Government; Travel and Transportation; Commerce and Manufacturing; Natural Resources; Public Finances, Currency, and Banking; Labor Conditions and Educational Systems. Each of these subjects has been discussed by an authority and is replete with descriptive, historical and statistical data. The appendix includes practical suggestions for the business traveler in Mexico, and gives details concerning postal and tariff regulations, the recent colonization decree, and the treaties now in force between Mexico and the United States. It contains also a bibliography of works on Mexico. Three maps show the political divisions, principal cities, lines of communication, mining centers and the Panuco-Tuxpam oil fields.

Pioneer Investigations of Acoustics

REVIEWED BY F. R. WATSON
Professor of Experimental Physics University of Illinois

COLLECTED PAPERS ON ACOUSTICS—By Wallace C. Sabine, Late Hollis Professor of Mathematics and Natural Philosophy in Harvard University. Edited by Theodore Lyman, Cambridge, Mass.: Harvard University Press. Cloth; 8 x 11 in.; pp. 279; illustrated. $4.

Professor Sabine's important investigations in architectural acoustics have been set forth in various periodicals since 1900. His unexpected death in 1919 made it desirable to publish the available results of his work in a single volume. The labor of collecting this information was undertaken by Prof. Theodore Lyman, a colleague of Professor Sabine's, who also acted as editor for the publication.

The papers deal almost entirely with the acoustics of buildings. The larger part of the discussion concerns the action of sound in auditoriums, a question which first engaged Prof. Sabine's attention. Two papers on The Insulation of Sound and Building Material and Musical Pitch mark the beginnings of a fundamental investigation of a second important problem which unfortunately was interrupted by Prof. Sabine's death. A paper entitled Melody and the Origin of the Musical Scale suggests the theory that the musical scale might have been developed when enclosed rooms were first used because of the prolongation and overlapping of successive tones in singing. Whispering Galleries is the title of a paper dealing with the whispering phenomena exhibited in some rooms and natural caverns.

The extension papers on Reverberation give important conclusions concerning the acoustics of auditoriums that resulted from Prof. Sabine's pioneer work in this little-understood subject. He developed the formula: $t = kV \div a$ where t is the time taken for a sound of standard intensity to die out in a room, k is a constant, V the volume of the room and a the sound absorbing power of all the surfaces. To make the formula of practical use, he experimentally determined the coefficients of absorption for the surfaces usually found in auditoriums—plaster, wood, glass, etc.—as well as individual objects, such as chairs, people, pictures, etc. By means of this equation and the constants, any auditorium, whether already constructed or in the process of design, can be analyzed and recommendations given for securing satisfactory acoustics.

Prof. Sabine's substantial findings have given confidence to other investigators to proceed in this difficult domain. In the United States, additional investigations have been made by Stewart, Watson and P. E. Sabine. (See Bibliographies in Bulletins 73, 87 and 127 of the University of Illinois Engineering Experiment Station, Urbana, Ill.) Prof. Franklin in America and Jäger in Vienna developed reverberation formulas from theoretical considerations that conformed with Sabine's results. Aigner in Vienna calculated sound-absorbing coefficients by instrumental measurements that were in agreement with the ear measurements taken by Sabine. A recent book by Eugen Michael, Hörsamkeit Grosser Räume, draws heavily from Sabine's conclusions.

It may well be said that the investigations described in these Collected Papers clear the subject of acoustics of buildings from the fog of mystery that previously enveloped it and allow the essential phenomena to be seen in the light of scientific laws. Prof. Sabine's pioneer results furnish the basis for any further advances in this field.

PUBLICATIONS RECEIVED

AMERICAN GOOD ROADS CONGRESS, 1922—New York: American Road Builders' Association, 11 Waverly Place. Cloth; 6 x 9 in.; pp. 273; illustrated. $3.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION: Proceedings, 1921—Secretary, C. A. Lichty (C. & N. W. Ry.), Chicago. Cloth; 6 x 9 in.; pp. 246; illustrated. $1.

Reports are given on cinder pits, station platforms, tunnel lining, tool equipment for pile drivers, treated timber and repairing leaks in water mains.

APPLIED CALCULUS—By F. E. P. Bisacre, P.B.E., M.A. (Cantab.) B.Sc. (London) A.M.Inst.C.E. New York: D. Van Nostrand Co. Cloth; 5 x 7 in.; pp. 446; illustrated. $3.75 net.

ASSETS OF THE IDEAL CITY—By Charles M. Fassett, Specialist in Municipal Government at the University of Kansas; former Mayor of Spokane. New York: Thomas Y. Crowell Co. Cloth; 5 x 8 in.; pp. 177. $1.50 net.

THE BORDER METHOD OF IRRIGATION—By Samuel Fortier, Associate Chief, Division of Agricultural Engineering. Farmers' Bulletin 1243, United States Department of Agriculture, Washington, D. C. Paper; 6 x 9 in.; pp. 41; illustrated.

CITY OF ALEXANDRIA TOWN PLANNING SCHEME—By W. H. McLean, M.Inst. C.E., Member of the Institution of Municipal and County Engineers; Member of the Town Planning Institute; Engineer-in-Chief, Municipality of Alexandria. Cairo; Ministry of Finance. Boards; 8 x 14 in.; pp. 18; maps and halftone plates. P. T. 50.

Besides street plan, parks, transportation, zoning, housing, etc., this report includes a historical sketch dealing with the Ptolemaic Arab and modern Alexandria.

CITY PLAN FOR EAST ORANGE, N. J.—Prepared by the City Plan Commission; Technical Advisory Corporation, Consulting Engineers, New York City. Paper; 8 x 11 in.; pp. 80; 4 maps.

A comprehensive report on all phases of city planning and public improvements. Contains novel score sheet for choosing among nine civic center sites, population curves, municipal program for public improvements to fit future financial ability of city.

CONCRETE COMPUTATION CHARTS—By Mr. Richard T. Dana, M. Am. Soc. C. E., Chief Engineer, Construction Service Co. and James M. Kingsley, B.S. New York: The Author, 119 Broad St. Flexible; 9 x 12 in.; pp. 14; 21 full-page diagrams. $5.

DEPARTMENT OF CONSERVATION AND DEVELOPMENT, STATE OF NEW JERSEY—Annual Report, 1920-21—Trenton. Paper; 6 x 9 in.; pp. 103; illustrated.

DIVISION OF HIGHWAYS AND THE REGISTRY OF MOTOR VEHICLES—Annual Report of the Department of Public Works, The Commonwealth of Massachusetts, 1920-21. Paper; 6 x 9 in.; pp. 141; illustrated.

EINFACHE, RECHNERISCHE BEHANDLUNG des Durchlaufenden Trägers für Unbewegliche Lasten—Zahlenbeispiele Anwendungbeispiele für den Eisenbeton. By G. Soll, Dipl.-Ing., Studienrat an der Staatlichen Baugewerkschule in Barmen-Elberfeld. Berlin: Wilhelm Ernst & Sohn. Paper; 6 x 9 in.; pp. 112; 42 text figures.

THE EMPIRE MUNICIPAL DIRECTORY AND YEAR BOOK, 1922-1923—London: Municipal Engineering and the Sanitary Record (The Sanitary Publishing Co., Ltd.). Cloth; 7 x 9 in.; pp. 288. 11s. net.

Like the previous edition of this useful work, noted in these columns Aug. 18, 1921, p. 289.

ENGINEERING AND LEGAL ASPECTS OF LAND DRAINAGE IN ILLINOIS—By G. W. Pickels and F. B. Leonard, Jr. Urbana, Ill.: State Geological Survey. Cloth; 7 x 10 in.; pp. 322; map in pocket.

Besides a review of the status of drainage in Illinois, gives information regarding 29 drainage areas.

THE ENGINEERING FOUNDATION: Report for 1921-22 and a Report of Research on The Fatigue of Metals—Engineering Societies Building, New York, N. Y. Paper; 7 x 10 in.; pp. 92; illustrated.

THE ENGINEERING INDEX, 1921—Compiled by The American Society of Mechanical Engineers, New York City. Cloth; 6 x 9 in.; pp. 584. $6.

Follows general lines of 1920 and 1919 issues. Contains over 14,000 items, referring to articles in 600 publications, the selections having beeen made from 100-odd periodicals, etc. The 1920 Index was noticed at length in these columns for Sept. 15, 1921, p. 456.

FOR COMPULSORY LICENSE OF PATENTS—How the Stanley Bill (S. 3410) Imperils Inventors, Manufacturers, and The American Patent System. Washington, D. C.: American Patent Law Association, 614-619 Washington Loan & Trust Bldg.

HANDBOOK OF MUNICIPAL GOVERNMENT—By Charles M. Fassett, Specialist in Municipal Government at the University of Kansas; former Mayor of Spokane. New York: Thomas Y. Crowell Co. Cloth; 5 x 8 in.; pp. 192. $1.50 net.

HUMAN FACTORS IN INDUSTRY: A study of Group Organization—By Harry Tupper. New York: Ronald Press Co. Cloth; 5 x 8 in.; pp. 280. $2.

HYDRAULIC CALCULATOR for the Solution of Flow of Water Problems in Canals, Flumes, Culverts, Pipe Lines, etc.—Devised and for sale by J. R. Jahn, M.S., Irrigation Engineer, Berkeley, Cal. Diagrams mounted on one piece of 8 x 12-in. stiff cardboard, accompanied by flexible transparent straight edge and 8-p. pamphlet of directions for use. $5.

A nomographic chart for the purposes stated above and for various other calculations incident to irrigation, water power and water supply, including pumping plants, weirs and earthwork estimates. Values for "n" in open and closed conduits and for "V" in open canals are suggested.

INDUSTRIAL DIRECTORY AND SHIPPERS' GUIDE—New York: New York Central Lines. Cloth; 8 x 11 in.; pp. 968; maps and half-tones.

A compendium of information concerning the several railroads of the New York Central system and the communities along its lines, with suggestions and instructions for shippers as to packing, claims and related subjects. Aims to promote American industries by acquainting business men with the traffic facilities of the railroad system it describes. Successive editions are proposed.

INVESTIGATION OF THE PROPORTIONING OF CONCRETE MIXTURES—1921—By Peter Gillespie, Professor of Civil Engineering, and A. R. Duff, Research Assistant, University of Toronto (Ont.), Faculty of Applied Science and Engineering, School of Engineering Research. Paper; 6 x 9 in.; pp. 13; illustrated.

JOINT TERMINALS AT CHICAGO, ILL.: Report of Board of Economics and Engineering to S. Davies Warfield, President, National Association of Owners of Railroad Securities, Inc., 1 Madison Ave., New York City. Paper; 8 x 11 in.; pp. 38; 16 maps.

Owing to the reduction of net revenues by mounting terminal costs the board named above decided to investigate joint terminals, and selected Chicago and New York for that purpose. The Chicago report contains many valuable data. Col. F. A. Molitor is chairman of the board.

THE LOCAL GOVERNMENT OF THE UNITED KINGDOM—By John J. Clarke, M.A., F.S.S., Lecturer in Law of Housing and Town Planning in the University of Liverpool; Lecturer in Public Administration, Local Government and Citizenship for the Liverpool Education Authorities. With a Foreword by Sir Homewood Crawford. London, Toronto, New York: Sir Isaac Pitman & Sons, Ltd. Cloth; 5 x 7 in.; pp. 374. 8s.

NEW SOUTH WALES WATER CONSERVATION AND IRRIGATION COMMISSION: Report for 1920-21—Sydney, N. S. W. Paper; 9 x 13 in.; pp. 32. 2s.

OBSERVACIONES HIDROLOGICAS, 1911-20—Boletin 102, Cuerpo de Ingenieros de Mines del Peru. Por Pedro Garcfa Gastañeta, Jefe Hidrólogo. Lima. Paper; 7 x 10 in.; pp. 156; tables.

PREPARATION AND USES OF TAR AND ITS SIMPLE CRUDE DERIVATIVES—By W. W. Odell. Prepared under a co-operative Agreement with the Illinois State Geological Survey and the Department of Mining Engineering of the University of Illinois. Washington: Bureau of Mines. Paper; 6 x 9 in.; pp. 84.

REPORT ON DRAINAGE AND PREVENTION OF OVERFLOW IN THE VALLEY OF THE RED RIVER OF THE NORTH—By P. T. Simons, senior Drainage Engineer, and Forest V. King, Drainage Engineer. Washington: Bureau of Public Roads. Paper; 6 x 9 in.; pp. 89; illustrated. 50c.

ROAD DRAG COMPETITION: Report of the Ninth Annual Competition, Saskatchewan Department of Highways, Regina—Paper; 6 x 9 in.; pp. 20.

SELECTED PROFESSIONAL AND BUSINESS BOOKS—Compiled by Scovell, Wellington & Co., Accountants-Engineers, Boston 9, Mass. Paper; 4 x 9 in.; pp. 25.

Mostly books on accounting, auditing, banking, advertising and selling; includes a few on municipal government, a number on engineering and industry, and some on economics, etc.; 400 in all.

SEPARATION OF STREET AND RAILROAD GRADES, PATERSON, N. J.—A Report of the City Plan Commission by Herbert S. Swan and George W. Tuttle. Paper; 8 x 11 in.; pp. 29.

Includes plans but no cost estimates for elimination of all grade crossings on Erie, Susquehanna and Lackawanna railroads.

SOUND-PROOF PARTITIONS: An Investigation of the Acoustic Properties of Various Building Materials with Practical Applications—By F. R. Watson, Professor of Experimental Physics, University of Illinois, Engineering Experiment Station. Paper; 6 x 9 in.; pp. 83; illustrated. 45c.

STATISTICS OF COMMON CARRIERS, 1920: Preliminary Abstract—Washington, D. C.: Interstate Commerce Commission. Paper; 9 x 12 in.; pp. 221.

STREAM POLLUTION STUDIES—By Russell Suter, Senior Assistant Engineer, and Emmeline Moore, Investigator in Fish Culture; and Studies in Oyster Culture, by William Firth Wells, Biologist and Sanitarian. Albany, N. Y.: State Conservation Commission. Paper; 6 x 9 in.; pp. 34; illustrated.

TENTATIVE ZONING PLAN FOR AKRON, OHIO; Also Report on Limitation of Heights of Buildings—City Planning Commission, E. A. Zeisloft, Chief Engineer and Secretary; Charles F. Fisher, Planning Engineer. Paper; 6 x 9 in.; pp. 22 and 15.

THE THOROUGHFARES AND TRAFFIC OF PATERSON—A Report of the City Plan Commission. Prepared by Herbert S. Swan, Consultant. Paper; 8 x 11 in.; pp. 82; illustrated.

A comprehensive report. Gives much attention to the way the traffic is hindered by lack of a city plan, narrow and dead-end streets, grade crossings, poor routings of street railways and jitneys. Improvements mapped out and ways and means of providing them suggested.

WORK IN COMPRESSED AIR AND IN TUNNEL CONSTRUCTION—Industrial Code Rules (as amended) of New York State Industrial Board, Effective May 1, 1922. Albany, or 124 E. 28th St., New York City. Paper; 5 x 8 in.; pp. 35.

WATER SUPPLY NEEDS AND RESOURCES OF THE COMMONWEALTH: Report of the Joint Board Consisting of the State Department of Health [of Massachusetts] and the Metropolitan District Commission. Boston. Paper; 6 x 9 in., pp. 283; folding maps.

Deals chiefly with an additional water supply for Boston and vicinity and Worcester, but proposes several other districts. Abstracted at length in *Engineering News-Record*, March 2, p. 360.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Trusses Should Rest on Columns

Sir—The particular point again emphasized by the Knickerbocker Theater disaster is one which has long been recognized by structural engineers, namely, the necessity of firm anchorage of trusses to suitable steel columns.

It would be impressive if there could be generally circulated pictures made after the earthquake of 1906 of certain San Francisco structures showing wrecks similar to that of the Knickerbocker Theater, which would not have occured with trusses firmly fastened to their supports. The trusses at the North Beach Power House of the United Railroads, for example, were set on pilasters and were shaken off by the earthquake. The wreck of the Majestic Theater was even worse, and if the shake had come at a time when the parquet was filled with people few would have escaped.

In his report on the condition of buildings in San Francisco after the earthquake, A. L. A. Himmelwright concluded his remarks about the Majestic Theater as follows: "The inadvisability and danger of carrying large trusses on bearing walls at great height, as was done in this case, is clearly shown. Steel columns should be provided and the trusses rigidly connected to them and braced." Such fundamental principles of good structural practice should be incorporated in the building laws of all cities and then should be enforced.

ARTHUR J. GRIER.

Oakland, Cal.
Mar. 30.

Questionnaire for Prospective Bidders

Sir—The following questionnaire is a suggested method of restricting competition to responsible contractors, either on public or private work, when advertising for bids, following out the principles laid down by Secretary Hoover's Conference on a Standard Contract Document, which advocated: "The award of contracts on a basis of skill, integrity and responsibility, with the policy, where practicable, of eliminating irresponsible or inappropriate bidders before their proposals are received."

The suggestion is, briefly, to have the designing engineer or architect do in advance what he always does after bids are received, namely, consider the merits and ability of the various bidders. It requires that the designer request each bidder to answer a questionnaire on the three points of skill, integrity and responsibility. If the answers are satisfactory the applicant is allowed to take a set of plans and specifications and make a bid, and the lowest of these is automatically awarded the contract. If the answers are not satisfactory he is not allowed to bid.

It is believed that if this method, or some similar one, were generally followed it would in a few years revolutionize the construction industry because it would eliminate all irresponsible and ignorant contractors, many of whom are crooked, and leave only the other kind. These would have an opportunity to make a profit, and as they can do work as cheaply as it can be done and done rightly, the owner of the building would be benefited by restricting his work to this class; therefore, all parties to the industry would be benefited.

L. C. WASON,
Aberthaw Construction Co.

Boston, Mass.
May 3.

QUESTIONNAIRE

The following information is for my personal use and will be treated strictly confidentially by me.

Signed.....
Architect.

SKILL:

1. How long have you been in business as a contractor?
2. How long have you been in responsible charge of work?
3. What training in school, college, or elsewhere have you had to fit you for this business?
4. Give a concise outline of the work you have done with examples and dates from your start in the contracting business.
5. Give a list of similar work to that in view with brief description, size, location and date that you have executed.
6. Have you a skilled superintendent now in your employ competent to be entrusted with executing the work in view?
7. State the training and experience of the man you propose to put in charge of this work.
8. Have you now in your employ the principal assistants to the works' superintendent for the work in view?
9. State their position, training and experience.

INTEGRITY:

10. Give the name and address of the last five Architects (or Engineers) and the owners of the work with address for whom you have completed contracts.
11. Will you give them as references?
12. Have you any objection to my inquiring of any or all of them about you?
13. If so, why?
14. Give any other references you care to.
15. Has any work been taken out of your control due to dissatisfaction of Architect (or Engineer) or Owner?
16. If so, describe the case.
17. Have any of your contracts resulted in law suits?
18. If so, describe the cases.
19. Have you had controversies with your sub-contractor.....or with municipal building departmens?
20. If so, state the nature of them?

RESPONSIBILITY:

21. I estimate that if you fulfill the requirement of plans, specifications and contract as to progress the amount of cash and credit required of contractor before first payment is made will be $....., and that the maximum requirements of cash or credit in the most active period of the work between payments will be $.....
22. Have you the required resources in cash or credit?
23. Give a condensed statement of assets and liabilities.
24. What volume of work have you unfinished in $.....
25. How much cash or credit does this require?
26. How much cash or credit does this leave free for other work?
27. I estimate approximately that the following plant will be the minimum amount needed to properly handle this work.
28. Have you this amount of your own available for the work?
29. If not, do you know that you can get it as and when needed?

Moon Phases and Timber Life

Sir—Many years ago, when traveling over the Panama R.R., an American roadmaster pointed out sound hardwood ties which had been in the track ever since it had been laid 40 years previously, while others which had not been laid 12 months were quite rotten. The explanation given was that these last had been cut at the wrong time in the month.

Later, while building a railroad in a low tropical district of Columbia, I collected what information I could on the subject, of which the following is a summary.

1. In the first and second quarters of the moon—called "Cresciente"—the natives never fell timber because they say, it is full of sap. Only in the third and fourth quarters—called "Minguante" do they cut, when they say the sap is down. They commence cutting after full moon.

2. The natives say that timber cut in "Cresciente" will speedily rot. Europeans, who have ignored this, admit that within twelve months the timber has so completely rotted as to require renewal.

3. Being tied down to a limited time under our contract we had to fell continuously. Within twelve months after being laid some of the "Cumula" sleepers showed signs of rot with fungi growing on them, although laid in sand ballast, and well drained.

4. A keen lady gardener in this district said she always planted her flower seeds in the third and fourth quarter, because, when planted in the other quarters, they grew up but never flowered.

5. In the temperate climate of the Bogota plateau (elevation 8,600 ft.) and in the lands at a higher elevation the natives cut timber at all phases of the moon.

The timbers we used for ties were principally Cumula and Guayacan, but a few Diomate were admitted. Particulars are as follows:

Name	Sp.gr.	Weight in lb. per cu.ft.
1. Cumula	1.785	49
2. Diomate*	1.04	65
3. Guayacan†	0.94	60

Remarks—*Sinks in water but Sapwood floats. †Just floats. "Zygophillum arboreum" also called "Guayacan polvillo," a very similar timber to Greenheart.

ROBT. I. MONEY.

London, Eng.,
April 24.

NEWS OF THE WEEK

New York, May 18, 1922

Propose New Rapid Transit Routes for New York

Transit Commission Announces Plans for $218,000,000 Project—City Government Hostile

New rapid transit subways aggregating 32.55 miles in length with a trackage of 84.20 miles are included in the plans announced last week by the New York Transit Commission. It is expected that the cost of construction, estimated as $218,000,000, will be raised through the sale of city bonds. Means for providing the $100,000,000 estimated as the cost of equipment, will depend on the outcome of the movement now under way to reorganize the existing transit system in accordance with the Transit Commissions Plan.

Before construction of any of the new lines can be begun public hearings must be held, the routes legalized, and appropriations made by the Board of Estimate and apportionment of New York City. The available margin of the city's borrowing capacity has not been determined exactly, but it is understood to be substantial. If the reorganization plan for the existing transit system should be adopted and the lines established on a paying basis the city funds now tied up in those lines would be released from the debt limit and made available.

May Be Delay

Although the need for additional transit facilities is urgent, action on the proposed plan will probably be deferred as a result of the long-standing controversy between the Transit Commission and the city government relative to transit matters. Already news reports foreshadow a hostile attitude on the part of the Board of Estimate and Apportionment which, under the regular procedure in subway construction, has several opportunities to interpose obstruction. Mayor Hylan has announced that the city administration will soon make public a program of its own, looking to recapture by the city of some of the existing lines and formation of a system to be city-operated as well as city-owned. He has declared that city funds will be appropriated only on such a basis. Even under favorable conditions the time required to build a new subway including the laying out and validation of routes, the drawing of plans, the preparation of contracts and the actual construction varies from three to five years.

The routes now proposed are as follows (see map on p. 843):

1. Extension of the Corona line, in north Queens, from Corona to Flushing.
2. Extension of the 42d St. crosstown line in Manhattan, with a moving platform connecting with all existing and future north and south rapid transit lines, both subway and elevated.
3. A Staten Island tunnel to connect with the Fourth Ave. subway in Brooklyn, and with the steam and trolley lines on Staten Island.
4. Extension of the Broadway-Seventh Ave. line of the Brooklyn Rapid Transit system from 59th St., Manhattan under Central Park West, 110th St., and Seventh Ave. to 155th St.
5. A Brooklyn crosstown line from Queensborough Plaza in Long Island City to connect with the Brighton Beach line at or near Franklin Ave. and Fulton St., Brooklyn.
6. A new subway and East River tunnel to connect the Fulton St. elevated line, in Brooklyn, with the Broadway-Fourth Ave. line at the City Hall station in Manhattan.
7. A new trunk line subway to run from downtown Manhattan to Washington Heights, following in the main, Eighth and Amsterdam Avenues.

It is the judgment of the Commission that so far as possible, work on all these lines should be taken up at once and that the entire program should be carried out by units, each of which may be operated as a part of the transit system immediately on completion. The plans contemplate such a procedure, in the interest both of speedy increase in facilities and of reduction in amount of accumulated interest on cost of construction.

The plans now presented have been prepared by Daniel L. Turner, consulting engineer to the Transit Commission. Preparation of construction plans and specifications and supervision of construction will be under the direction of Robert Ridgway, chief engineer.

Am. Soc. T. M. Nominations

The nominating committee of the American Society for Testing Materials has announced the following regular nominations for officers to be voted on at the coming annual meeting; President, George K. Burgess, U. S. Bureau of Standards; vice-president, W. H. Walker, Massachusetts Institute of Technology; members of the executive committee D. M. Buck, W. M. Corse, W. K. Hatt, and J. R. Onderdonk.

Lower Niagara Arch to Be Four-tracked

The four-tracking of the lower arch bridge across the Niagara River gorge, used by the Grand Trunk Railway, is under contemplation by the company which owns the structure, the Niagara Railway Arch Bridge Co. C. E. Fowler, New York City, has been retained as engineer.

To Spend $3,000,000 on Buildings for Auto Plant

Announcement has been made by A. R. Erskine, president of the Studebaker Corp., of South Bend, Ind., that the board of directors had authorized the expenditure of $3,000,000 for the erection of new buildings. Construction will begin immediately. It is planned to employ 2,000 additional men before the first of the year.

Making a Plan for New York and Its Environs

Surveys Under N. P. Lewis and Program for Regional Plan Announced By Russell Sage Foundation

At a largely attended meeting of public officials, architects, engineers, city planning experts and others, held at the Auditorium of the Engineering Societies' Building, New York City, on the evening of May 10, called by the trustees of the Russell Sage Foundation, details were given out for the first time of a survey of New York City and its environs in three states that has been under way for a year or more looking forward to a comprehensive regional plan for the district indicated. This survey, together with the further work on the plan itself, is being financed primarily by the Russell Sage Foundation, with assistance from a large number of citizens.

For more than a year past, a physical survey of the district in question has been under way by Nelson P. Lewis, formerly chief engineer of the Board of Estimate and Apportionment, New York City, assisted by a staff of engineers. During this period Mr. Lewis has had the aid and advice, among others, of D. L. Turner, consulting engineer, New York Transit Commission; Benjamin F. Cresson, Jr., chief engineer, Port of New York Authority; Jay Downer, engineer Bronx Parkway Commission, New York City; Morris R. Sherrerd, consulting engineer, Department of Streets and Public Improvements, Newark, N. J.; Frederick L. Olmstead, city planner and landscape architect, Brookline, Mass.; and George C. Whipple, professor of sanitary engineering at Harvard University, Cambridge, Mass., and of Hazen, Whipple & Fuller, civil engineers, New York City.

Committee in Charge

The general direction of the survey and planning work is in charge of a committee appointed by the trustees of the Russell Sage Foundation, which has as its chairman Charles D. Norton, formerly chairman of the Chicago City Plan Commission; as secretary, Frederick P. Keppel, formerly dean of Columbia College and Assistant Secretary of War; as assistant secretary, Flavel Shurtleff, secretary of the National City Planning Conference.

In his address at the meeting last week, chairman Norton said that Mr. Lewis, "with the aid of a special group, including William A. Delano, Jules Guerin, George D. Pratt and Sherman Fairchild," hopes "to develop a new type of map for city planning, in which the painter with his mastery of arrangement and color, will be guided by the accurate contours of the engineer and the new viewpoint of the aerial photographer."

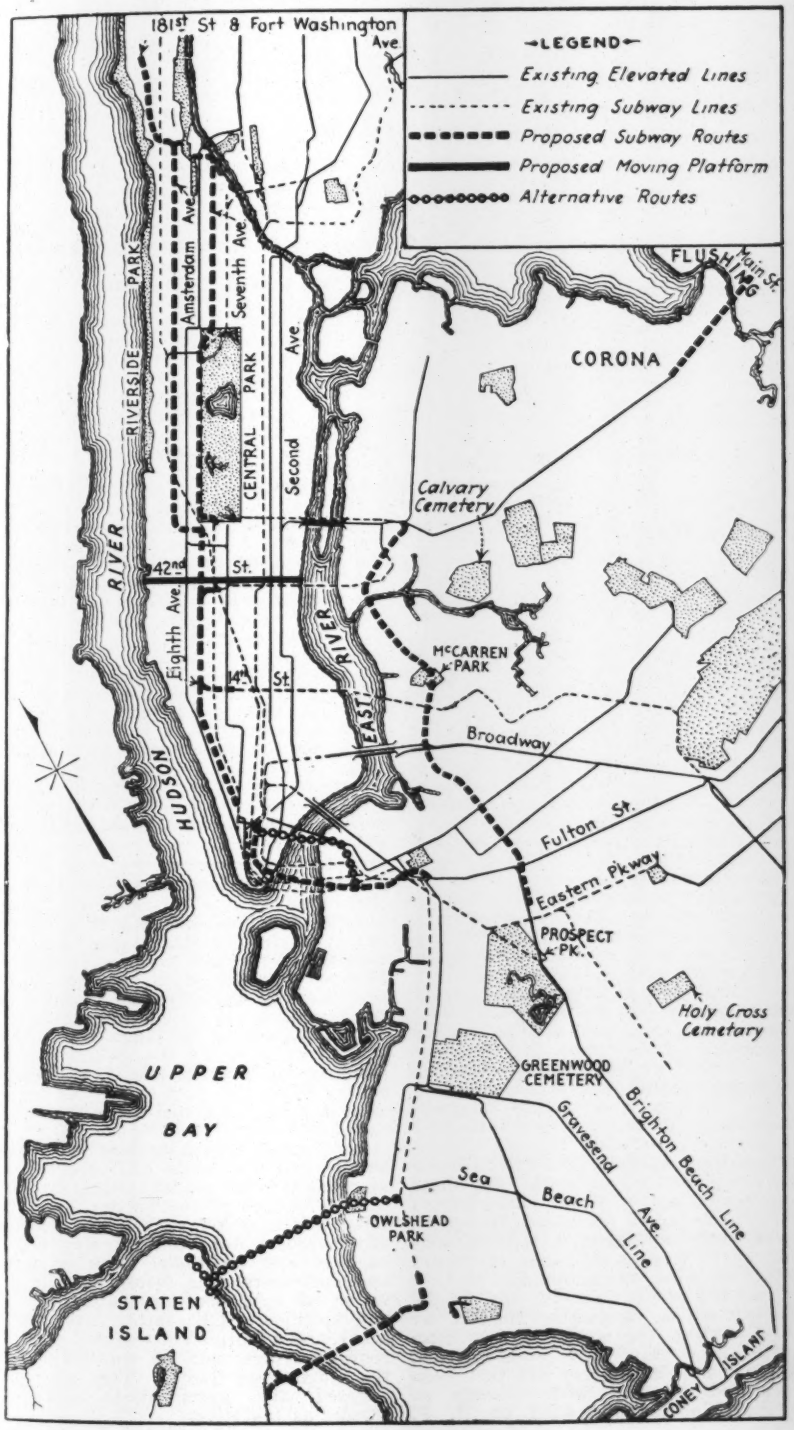
Besides the engineering and physical survey, the studies under way and proposed include a consideration of eco-

(Continued on p. 846)

To Vote on $12,800,000 Bonds for Los Angeles Outfall Sewer

Los Angeles, Cal., will vote Aug. 29 on a $12,800,000 bond issue for a new ocean outfall sewer and a sewage-screening plant at Hyperion, instead of Aug. 12, as announced in *Engineering News-Record*, April 13, 1922, p. 618. The city is committed to no particular type of fine screens, according to information received from W. T. Knowlton, engineer of sewers, who also states that the local section of the American Society of Civil Engineers has withdrawn from the report of its committee, abstracted in the issue of this journal mentioned above, all that portion relating to increasing the capacity of the present outfall sewer by using pumps.

Routes Proposed in New York's New Transit Plans



Illegal Election Charged at Road Builders' Meeting

Controversy Over Vote on New Officers and Directors Ends in Adjournment Until June 15

Following charges of illegality in the conduct of the election of officers and directors, the annual meeting of the American Road Builders' Association, held at the Automobile Club of America, New York City, May 15, adjourned, after a heated session, to reconvene June 15 for the purpose of deciding the isues on which no agreement was reached after an entire evening's debate. A deadlock resulted in the attempt of the Board of Direcors to choose a president, the two candidates, Thomas J. Wasser, state highway engineer of New Jersey, and Col. W. D. Uhler, chief engineer of the Pennsylvania Highway Commission, each receiving 14 votes.

The chief controversy, however, involved the election, by letter ballot, of seven new directors. At the beginning of the evening session the president of the association, Col. H. L. Bowlby, of Washington, D. C., announced the election, as directors, of Col. R. Keith Compton, Baltimore; George C. Diehl, Buffalo; H. K. Bishop, Washington; C. P. Fortney, Charleston; W. R. Neel, Atlanta; F. S. Bramley, Cleveland; and Frank Terrace, Seattle.

Protest Made

The foregoing result was immediately protested by Major F. A. Reimer, of East Orange, N. J., on the ground that letter ballots had not been distributed to the membership at least thirty days before the date of the annual meeting as provided for in Chapter 2 of the by-laws of the constitution. Evidence in the form of a postmarked envelope and verbal testimony was produced to support this contention and it was claimed that during the afternoon session E. L. Powers, secretary of the association, had admitted that the sending out of the ballots had been delayed. Col. Bowlby refused to receive the evidence as valid and Mr. Powers, who was seated beside him, volunteered no explanation in reply to the charge that had been made except to say that he was sick when the ballots were mailed and could not specify the date on which they left his office.

Major Reimer then offered a resolution demanding that the report of the tellers be laid upon the table. The motion was duly seconded but the president, in his capacity as presiding officer, refused to put the resolution to a vote. A resolution calling for an appeal from the decision of the chair on this point was made and seconded and on this question, also, Col. Bowlby refused to call for a vote. His point was that the election was legal because, even on the assumption that the ballots went out late, the membership had had ample time to register their choice and ballots had been received and counted from as far west as the Pacific Coast.

Bertrand H. Wait, of New York, emphasized the fact that the delayed issue of the ballot was immediately followed up by an electioneering campaign by Col. Bowlby, who had sent out a letter on the official stationery of the American Road Builders' Association in support of seven candidates for directorships. This action, Mr. Wait maintained, took an unfair advantage

of those desiring to support other candidates and left them insufficient time in which to organize effective support for another ticket.

The meeting by this time had divided into two factions and an acrid debate followed. A point was reached where a resolution was offered and seconded, but not voted upon, calling for an appropriation of $2,500 of the association's funds to pay for court proceedings and counsel fees. The discussion closed with neither side making concessions and presumably the question of fact as to the date of sending out from the secretary's office the ballots for the vote on directors will be investigated between now and June 15 and reported on at the adjourned meeting on the latter date.

Vote for Officers

On the other point, relating to the vote of the directors for officers, resulting in the tie between Mr. Wasser, the nominating committee's choice, and Col. Uhler, whose name had been written in on the ballots cast for him, it was charged that the vote of at least one director, which had been sent by mail, had not been received and recorded.

As vice-presidents of the association, the directors elected F. E. Everett, for the Northeastern District; Frank Page, for the Southern District; J. Frank Smith for the Central District; and Samuel Hill for the western district. For secretary the directors cast 15 votes for E. L. Powers, the present incumbent, and 12 votes for Charles M. Upham, state highway engineer of North Carolina. J. H. McDonald, of Connecticut, was re-elected treasurer.

The combination of circumstances involving the protest of the election of directors and the tie vote for president by the Board of Directors, presents a complicated issue. Mr. Wasser is at present a director, with his term of office expiring with this year's annual meeting. The constitution provides that the president must be chosen from among the membership of the Board of Directors. If, as Col. Bowlby held, the annual meeting cannot legally be adjourned until June 15, Mr. Wasser's term of office as a director automatically ceases and he therefore becomes ineligible as a candidate for president at a subsequent voting by the directors.

At the afternoon session a resolution was passed calling for an audit of the finances of the association, following a complaint that the reports of the secretary and treasurer had not been printed and sent to the members of the association at least ten days before the annual meeting, as required by section 5, chapter 3 of the by-laws of the constitution. In reply to a query as to why this provision had not been carried out, Secretary Powers answered that "it had become a dead letter."

This is the first time in the association's history that the annual meeting has been adjourned to a later date. A decision on the protested election of officers and directors is looked for at the June 15 meeting.

Boston Sells 4-Per Cent Bonds

Another notable break below the 4 per cent yield point for municipal bonds was recorded last week when Boston sold $1,233,000 of 4 per cent bonds at a premium. It is reported that the market rate will yield 3.85.

Discuss Window Protection and Special Fire Hazards

National Fire Protection Association Holds Meeting at Atlantic City May 9-11.

A round-table discussion of window protection for office buildings, stimulated by the fire which destroyed the upper half of the Burlington building in Chicago March 15, was the outstanding feature of interest at the annual meeting of the National Fire Protection Association, held at Atlantic City, May 9 to 11. The discussion, summarized on another page of this issue, gave emphasis to exposure-fire hazards.

The value of wire glass was given due credit, for example, in the statement that the Burlington building might have been saved if it had been equipped with wire glass on its north and east fronts. Protection additional to wire glass was considered to be necessary, however. Automatic rolling shutters such as are being applied by the American Telephone & Telegraph Co. to its exchange buildings were given high praise. Outside sprinklers which, when operated by heat, discharge a spray that runs down the outside of the exposed window, were also described as effective protection. Several cases of protection by automatic sprinklers inside the building were cited.

Reports Extensive

Automatic sprinklers, tanks, inflammable gases and inflammable liquids were the subject of extensive reports. Some amendments to the rules governing automatic sprinklers included one requiring dry-pipe systems to be kept dry instead of being operated as wet pipe systems in the summer months. New specifications for tanks were presented and finally adopted; they are a unification of the heretofore differing specifications of the association and the Associated Mutuals.

In the subject of gases, new rules for internal-combustion engines and producers were presented, amending the old rules. These also were finally adopted. Rules for acetylene systems and for acetylene compressing plants were presented by the same committee. Those for acetylene systems were referred to the executive committee to consider the relation of the rules to patented devices. The rules for compressing plants were continued as tentative. A refrigeration safety code was also offered in tentative form.

In the subject of inflammable liquids, the regulations for fuel oil plants were amended, an important change permitting electric preheating. Specifications for concrete fuel-oil tanks drawn in co-operation with the American Concrete Institute were finally adopted; these apply to heavy oils (35 Beaumé or heavier), including gas oil. Regulations were adopted also for oil-burning equipment for domestic use, these represented no important change from a tentative draft presented last year. As a wholly new item, a recommendation as to freeing oil tanks of vapors before entering was adopted.

Dust-explosion hazards are to be studied by a committee headed by D. J. Price; the work of this committee has only just been started. Another new committee has just been organized to deal with storage of combustible fibers, headed by R. P. Strong of the Louisiana Fire Protection Bureau.

Rules for the storage and handling of pyroxylin plastics, presented in tentative form last year, were finally adopted at this meeting. Reports were presented by the electrical committee, the signalling committee and others.

Two classes of buildings were the subject of work by the committee on building construction (ch., I. H. Woolson) during the past year. Class E office buildings (joisted brick construction), and frame dwelling houses. The latter contain no engineering rules but simply call for loads and stresses in accordance with good practice; on the subject of fire protection and suitable construction therefor they are unusually complete and practical. Suggested changes and additions, covering pro- and sprinklers (the latter over furnvision of roof scuttles, extinguishers and sprinklers (the latter over furnaces), and a more rigid requirement for roof coverings, will be considered by the committee later. The meeting adopted the specifications without change as tentative.

Dr. Henry Marion Howe

Dr. Henry M. Howe, professor emeritus of metallurgy at Columbia University, past-president and honorary member of the American Society for Testing Materials, and, during the World War, chairman of the engineering division of the National Research Council, died May 14 at his home in Bedford Hills, N. Y., in his seventy-fifth year. He was a leader in the science of metallography both in this country and abroad and his distinction brought recognition not only from his own country, where he was awarded the Fritz medal in 1917, but also formal honors from England, France, Russia, Germany and Sweden. In 1912 he was president of the International Association for Testing Materials and presided at the triennial meeting held that year in New York City.

Dr. Howe was graduated from the Boston Latin School in 1865, and from Harvard University in 1869, receiving from the latter institution a B.A. degree. Two years later he received the equivalent of a B.S. degree from the Massachusetts Institute of Technology. Harvard made him a Master of Arts in 1872 and a Doctor of Laws in 1905. After graduation he was identified with steel and copper works both in this country and Canada, and in 1883 he entered private practice in Boston as a consulting metallurgist. In 1897 he was made professor of metallurgy at Columbia University, a position which he held until his retirement in 1913.

His war work had to do largely with investigations into the making of gun steel, and due to his concentration on the subject of its metallurgy he was able to have reduced, to a large extent, the rejections in this class of ordnance that prevailed early in the United States' participation.

Dr. Howe was the author of many books on his specialty and was a frequent contributor to the proceedings of the technical societies. One of his chief contributions was a remarkable paper on the structure of steel which was read at the 1911 meeting of the American Society for Testing Materials.

He was a son of Julia Ward Howe, author of the "Battle Hymn of the Republic."

Canada Centralizes Control of Government-Owned Railways

Establishment of a single representative board of directors for the unified control of the government-owned lines has been announced by the Hon. W. C. Kennedy, Canadian Minister of Railways, as the first step in carrying out the government policy of reorganization. Under this new board will come the Grand Trunk properties, the Canadian Northern Ry., the Grand Trunk Pacific Ry., the Transcontinental Ry., and the Intercolonial and Prince Edward Island Ry. and branch lines. The minister stated that he was not in position to announce the personnel of the new board.

On the advice and recommendation of this board will depend the division of the unified system into operating units with regional headquarters. The aim of the management will be centralization of general direction and control and decentralization in local detail.

Want New Bid on Water-Works Dam for Columbus, Ohio

Due to the refusal of the lowest bidder to sign the contract awarded for the O'Shaughnessy dam for the water-works of Columbus, Ohio, new bids have been invited by the director of public service, to be opened on May 25. The contractor has sued to recover his certified check of $100,000.

The lowest of the 12 bids received for this work on April 20 was $1,001,616 from the Columbus Construction Co. The next highest bid was $1,115,119 from Thompson-Starrett Co., New York City. In all, there were seven bids below the engineers' estimate, which was $1,375,000. (Seen Construction News, this issue, for details.) C. B. Hoover is engineer in charge of the Columbus Bureau of Water-Works Extension, and Prof. John H. Gregory of Johns Hopkins University, Baltimore, Md., is consulting engineer.

The lower bidder claimed that he had made three errors in his bid, totaling about $73,500. He admitted on the stand that after allowing for the errors he would have a profit of $20,000 to $25,000, but urged that the margin was too small for so large a contract. The errors claimed were: (1) Sand figured at $1.60 per cu.yd. instead of the same unit price per ton, making a difference of $27,000; (2) on cement for concrete, an arithmetical error of 49c. per yard on 48,000 cu.yd., totaling $23,500; (3) overhead of $5,750 per month figured on only 20 months when it should have been 24, totaling $23,000.

The O'Shaughnessy dam is to be built across the Scioto River about 16 miles north of Columbus. It will be (1) an overfall masonry structure with a maximum height of about 70 ft. and a length of about 1,000 ft., including abutments flanked (2) on either side by earth embankments, making a total dam length of about 1,500 ft. There will be a roadway on top of the structure, carried across the overfall section on a 12-span reinforced-concrete arch bridge. Built into the masonry portion of the dam will be an outlet gate chamber, a power chamber and a pavillion. Down stream from the dam a spillway channel will be built to carry flood waters. The contract will also include about 5,400 ft. of new highway adjacent to the dam.

The Engineer in Public Life

While engineers, as a class, have been charged with neglect of public responsibilities, individual members of the profession have engaged in public service of a non-engineering character. "Engineering News-Record" is recording their activities in this series of biographical sketches.—EDITOR.

GEORGE C. DIEHL

In its selection of executive officers the American Automobile Association, this year, chose a civil engineer, George C. Diehl, of Buffalo, N. Y., as its president. For years Mr. Diehl has been a prominent figure in the good roads movement, and in addition to his consulting practice, he has served as county superintendent of highways of Erie County, N. Y., as engineer of many towns and villages in Western New York State, and as commissioner of Allegany State Park. He is a graduate of Rensselaer Polytechnic Institute, class of 1894.

Mr. Diehl has been prominent in a number of Buffalo activities. He is a past-president of the Buffalo Automobile Club and of the Buffalo Rotary Club, and served fifteen years in the National Guard of New York State with the various ranks up to that of major. He has been a member of many city and state boards and committees of the Buffalo Chamber of Commerce and other civic organizations. He has worked continually for the interests of boys and has served as chairman of the Boys Work Committee of the Y. M. C. A. in Buffalo and also as a member of the Boy Scout Council.

Flood Conditions at Dallas Halt Traffic

For the second time within two weeks, heavy rains have precipitated flood conditions in and around Dallas, Texas, menacing street car lines and cutting off steam and interurban traffic temporarily. The Trinity River, ordinarily a small sluggish stream dividing Dallas and Oak Cliff, a populous suburb, rose from 12.5 ft. at 7 a.m., May 8, to 41.6 ft. at 3 p.m., May 9. This flood crest is 0.7 ft. lower than the flood two weeks ago. Travel by railroad, interurban and highway has been paralyzed by destruction of bridges in every direction except to the north. However, as none of the bridges washed away was of unusual length through connections were quickly restored.

City Engineer George Fairtrace reports that six streets paved with wood blocks were made impassable in some sections and all streets of this type were damaged to some extent, due to the blocks buckling. All breaks will be replaced with brick as has been the custom for several years past.

A feature of the floods during the past two weeks has been the delivery of newspapers, mail and movie films by airplane.

Muscle Shoals Power Commonly Over-Estimated

In a paper read at the spring meeting of the American Society of Mechanical Engineers at Atlanta May 8 to 11, Charles G. Adsit, executive engineer, Georgia Railway & Power Co., says that the amount of available power at Muscle Shoals on the Tennessee River is much exaggerated in the published reports. He says that the greatest fluctuation in any stream in the Southeast probably occurs in the Tennessee River.

The government in planning the development at Muscle Shoals recognized this fact and contemplated an installation of 400,000 kw., only a portion of which can be depended upon for continuous power. In accordance with the hydrograph of the river at this point the amount of strictly primary power at Muscle Shoals averages 60,000 hp. and even this figure is based on the assistance of some steam capacity which must be maintained. The contemplated capacity of 400,000 kw. could be operated at full load only at widely separated intervals since the river does not equal this amount of power except on an average of less than thirty consecutive days per year. In 1904, for instance, the river flow curves show that at dam No. 2 (the Wilson dam) the flow would have produced only approximately 50,000 kw. for a large part of the year, while for the maximum of the year for a large part of the time the flow falls below 200,000 kw. A study of the hydrographs for a typical period show that the continuous output that can be depended upon throughout average years is in the neighborhood of 100,000 kw. Mr. Adsit says "It can be seen that the statement of 1,000,000 hp. which has appeared in the press repeatedly is a gross exaggeration of the output to be expected from the plant at this location."

Cleveland Business Men Oppose St. Lawrence Waterway

A committee of bankers, lawyers, and business men of the Cleveland Chamber of Commerce has reported against the St. Lawrence waterway project. In its report the committee declares that that "the financial condition of the country does not warrant the expenditure of the large sums that must be involved in the completion of the project," and expresses doubt that it can ever justify the expense.

New Power and Irrigation Project Near San Diego

Contract was awarded May 1 to Bent Brothers of Los Angeles for the construction of a dam on the San Louis Rey River in San Diego County, Cal., which is to cost $750,000 and which is the first step in a proposed $6,000,000 power and irrigation project. The project is to be carried out by the San Diego County Water Co. which is allied with the Santa Fe Ry. Co. Two other dams on the San Dieguito River are proposed for later construction. The plan is to store water for domestic purposes in the city of San Diego, for the development of power and for the irrigation, ultimately, of about 50,000 acres of land.

Federal-Aid Road Bill in Legislative Jam

House Instructs Conferees to Insist On Its Measure—Senate Has Different Views

(Washington Correspondence)

By a formal vote May 13 the House of Representatives instructed its conferees considering the postoffice appropriation bill to insist upon the highway bill passed by the House recently. This action means that the conferees will attempt to work out a compromise between the Senate highway proposition, which was put on the postoffice appropriation bill as a rider, and the bill as passed by the House.

Highway legislation, therefore, again is caught in a parliamentary jam, for the Senate Committee on Postoffices and Post Roads insists that the rider on the postoffice appropriation bill should prevail. It is believed the House will refuse to accept highway legislation as a rider on an appropriation bill.

The position of the House is that it has passed the highway bill which is now before the Senate committee. If it is not satisfactory to the Senate committee, it is pointed out that the measure may be amended as it sees fit. The differences then can be threshed out in conference. This contention would be stronger if an actual appropriation were made by the House bill. Instead it simply authorizes an appropriation and it is feared that much delay will ensue before the actual money is voted. On the other hand, the postoffice appropriation bill carries the actual money.

Differ on Cost Per Mile

There is very determined opposition in the Senate to any reduction in the existing maximum which the Federal Government many contribute. It is contended that the Federal Government should be willing to contribute as much as $20,000 per mile for primary roads since its is interested in having high class, interstate highways. By reducing the maximum to $12,500 during the next fiscal year and after that to $10,000 per mile, many states will not undertake to build the roads because they cannot construct a durable road meeting federal requirements for $20,000 or $25,000 per mile. Since the states must maintain these roads for all times to come, they will be insistent that the road be of a substantial character to start with.

Senator Pittman has introduced an amendment to the House bill excepting from the limitation of payment all roads included in the 7-per cent interstate system. In another amendment he provides that the limitation of payments shall not apply to those public land states containing unappropriated public lands exceeding 50 per cent of the total area of all lands in the state under consideration.

Votes Funds for Narrows Tunnel

The Board of Estimate and Apportionment of New York City has approved the plan for a joint freight and passenger tunnel connecting Brooklyn and Staten Island as described in *Engineering News-Record*, April 13, 1922, p. 626, and has appropriated $580,000 for engineering expenses. Application will be made for the consent of the Secretary of War to the crossing under the navigable waters of the Narrows.

Hurley and Goethals Testify at Cement Trial

Trade-Association Activities Discussed From Many Angles—Economics Professor Also Witness

The influence that the Federal Trade Commission might have had on the organization and activities of trade associations in general was told last week by Edward N. Hurley, former chairman of that body as well as of the U. S. Shipping Board, when called as a defense witness in the criminal trial of cement manufacturers of the Eastern district before Federal Judge Knox and a jury in New York City. Other prominent witnesses called by the defense included Major General George W. Goethals, U. S. Army, retired, now a consulting engineer in New York City; Dr. Thomas Sewell Adams, professor of economics at Yale University, and John P. Fernsler, a public accountant long connected with the Department of Justice.

Hurley's Testimony

Outstanding in the testimony of Mr. Hurley was his assertion, born out by documentary evidence, that, upon the invitation of John R. Morron, president of the Atlas Portland Cement Co., he had addressed members of the Portland Cement Association, including some of the present defendants, in May, 1916, upon the necessity of the government's securing adequate industrial and commercial data from the manufacturers of the country. To that end the Federal Trade Association had sent broadcast a questionnaire, securing such information as aggregate capital stock, bonded and other indebtedness, accumulated surplus or earnirgs invested in the business, net sales and net profits. With such information it was believed possible to diagnose business troubles, and the Federal Trade Commission stood ready to offer remedies. That commission, Mr. Hurley said in his speech before the Portland Cement Association, was endeavoring to secure more uniform and better methods of cost accounting, indorsing standard systems of bookkeeping, improving conditions among the employees, etc. He also said that "trade associations that are putting forth a special effort to improve their systems of cost accounting, bettering their processes of manufacturing, obtaining credit information and endeavoring to improve the welfare of their employees will be important factors in our country's development in the next few years."

The testimony of General Goethals was largely in connection with bids received and contracts executed for furnishing about 5,000,000 bbl. of cement used in the construction of the Panama Canal. The apparent reason for his testimony was an endeavor to establish the fact that competition to secure such a large contract was most keen, and that the transaction was entirely reasonable from the government's standpoint.

The defense sought, through his expert testimony, to establish the fact that whenever competition in marketing a product was most keen there was a strong tendency toward uniformity of prices and merchandising methods, a principle that Dr. Adams often enunciated. However, he asserted that though that tendency toward uniformity of price was present it did not necessarily indicate that competition alone would produce such a condition.

Dr. Adams also testified to the fact that a minimum average return for industrial concerns on capital stock would be 12 per cent per annum. This figure would allow, he asserted, a distribution of eight per cent to stockholders that would both keep the capital stock at near par value and also aid in the flotation of new bond issues which might be needed for expansions.

Through Mr. Fernsler the defense introduced numerous charts such as those showing the actual prices received by the defendant mills over the 1913-1921 period as against the mill bases compiled by government statisticians, total net earnings (federal income tax deducted) of the defendant companies over the same period, etc. In one of these charts he showed that the average income in per cent of gross receipts of all the defendant companies was, for the following years: 1913, 12.47 per cent; 1914, 14.39 per cent; 1915, 3.5 per cent; 1916, 15.66 per cent; 1917, 8 per cent; 1918, 5.5 per cent; 1919, 10.41 per cent; 1920, 5.18 per cent, and 1921, 5.01 per cent.

Mr. Hurley had testified previously to the fact that during his investigation of business conditions while chairman of the Federal Trade Commission a general net return on capital stock for all business would not average three per cent over a five year period, whereas he considered fifteen per cent not unreasonable.

Regional Plan for New York

(Concluded from p. 842)

nomic and industrial, legal, social and living condition problems. The committee of the Russell Sage Foundation, Mr. Norton stated, proposes "no abnormal expansion of public expenditure," but believes that "with a wisely conceived plan public funds which will be expended in any event can be directed into projects of permanent constructive value," while "without a plan millions are likely to be wasted in desultory or ill-considered public work."

Immediately after the conclusion of the explanatory address by Mr. Norton, Secretary Herbert Hoover arrived and was greeted by applause and the rising of the whole audience. His remarks are given elsewhere in this issue. Brig. Gen. John J. Carty, vice-president the American Telegraph & Telephone Co., noted telephone engineer, dwelt on the value of surveys and plans for telephone service in various cities of the country that have been made under his direction during the past thirty years. Elihu Root laid stress upon the fact that a city is a growth, responding to conditions not wholly political or economic — particularly to the needs of the various individuals who make up the city.

New York Mayors To Confer

At the thirteenth annual conference of mayors and other city officials of New York State to be held at Poughkeepsie, N. Y., June 6 to 8, there will be sectional meetings for city engineers, health officers, purchasing agents and various other classes of officials in the administrative branches of city government. The city engineers will meet on the morning and afternoon of Wednesday, June 7.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

NATIONAL CONFERENCE ON CITY PLANNING, Boston, Mass.; Annual Meeting, Springfield, Mass., June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 26-30.

PERSONAL NOTES

FRANK R. ALLEN has been appointed city engineer of Pine Bluff, Ark., succeeding J. H. Guest, resigned.

JAMES R. POLLOCK has resigned as assistant city engineer of Flint, Mich.

S. C. LIGGETT has been appointed assistant to T. F. LOUGHBOROUGH, district engineer for the Virginia State Highway Commission with headquarters at Staunton, Va. Mr. Liggett was formerly resident engineer in charge of state-aid work with headquarters at Richmond, Va. The new position is the result of recent reorganization which abolished resident engineers offices for both state and state-aid work and created eight districts with a district engineer in charge of all state and state-aid work in his district.

F. W. ULLIUS, JR., who has been village engineer of Shorewood, Wis., for nine years, has been appointed city planning engineer of Milwaukee, Wis., succeeding R. E. STOELTING, recently appointed commissioner of public works.

EDOUARD DE MEY, formerly shief engineer of Toupet, Beil & Conley, Inc., Pittsburgh, Pa., announces the severance of that connection and the formation of the firm of Conley & De Mey, contracting engineers, Pittsburgh, Pa. F. G. Conley, senior member of the new firm, was formerly secretary and treasurer of Toupet, Beil & Conley.

F. H. RICHARDSON has resigned as assistant engineer, Washington State Highway Department, to become field engineer with the Portland Cement Association, headquarters at Spokane, Wash.

FRED HORNKOHL, JR., formerly designing engineer with the Lehr Construction Co., St. Joseph, Mo., has become designing engineer with Charles W. Shaver, Salina, Kan.

J. T. MARTIN, formerly water commissioner of Cleveland, Ohio, has become associated with the Frazier-Ellms-Sheal Co., engineers, Cleveland, as vice-president and treasurer.

JOHN G. HIRSCH, formerly supervising engineer for Lockwood, Greene & Co., Chicago, Ill., and for Stone & Webster, Boston, Mass., has become associated with the Benham Engineering Co., consulting engineers, Kansas City, Mo., as principal assistant engineer.

MURRAY SULLIVAN, general manager of the Chinese Engineering & Development Co., Peking, China, has resigned and will return to America in June.

JOHN KERWIN, superintendent of tracks for the Detroit United Railway, who has been with the company for thirty years, will shortly retire to private life. Mr. Kerwin is the patentee of several labor saving devices, among them the Kerwin portable crossover, the Kirwin rail grinder and a railway tie which has been successfully used on the Detroit United Railway for the past two years.

G. E. WRIGHT, formerly assistant engineer with the city engineering department of Bridgeport, Conn., is now engaged in a similar capacity at Gloversville, N. Y.

COLONEL S. W. FLEMING, JR., of Gannett, Seelye & Fleming, Inc., Harrisburg, Pa., who is a member of the Pennsylvania French and Belgian Battlefield Commission, will spend two months making a thorough study of the battlefields in both countries.

OLAF HOFF has been appointed consulting engineer of the bridge to be built by the New York Central & Hudson River R.R. across the Hudson River near Castleton, and also of the bridge across the Niagara Gorge to be built by the Michigan Central R.R.

E. E. MAYO, formerly division engineer for the Southern Pacific Co., with Headquarters at Portland, Ore., has been transferred to the same position on the Sacramento division, with headquarters at Sacramento.

JOHN MCCLEARY, Jr., who for the past ten years has been contracting engineer for the Virginia Bridge & Iron Co., with headquarters at Memphis, Tenn., has been made manager of the new plant for the company at Birmingham, Ala.

WALTER C. RUSSELL, sanitary engineer of Flint, Mich., has resigned and will accept a similar position with the city of Richmond, Va.

JAMES R. POLLACK, assistant city engineer of Flint, Mich., has resigned.

EVERETT W. NICE, formerly construction engineer of the Dort Motor Co., has been appointed city engineer of Flint, Mich., succeeding E. C. Shoecraft, resigned.

STEPHEN KEARNEY, who has been city engineer of Lowell, Mass., since 1911, has tendered his resignation to take effect May 15.

OBITUARY

IGNACIO M. DE VARONA, who retired eight years ago as chief engineer of the Department of Water Supply, Gas & Electricity, New York City, after thirty years in the service of the city, died in New York, May 12. He was born in Cuba in 1842 and graduated from the Rensselaer Polytechnic Institute in 1863. In 1882 he began the extension of the Brooklyn waterworks. In 1904 he installed a high-pressure fire system in Brooklyn and later in Manhattan. He also prepared the plans for utilizing the Catskill water supply after delivery into the mains of the city's distribution system.

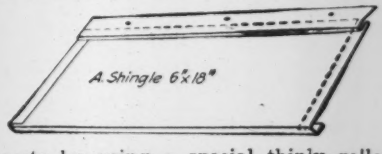
A. M. LOVIS, until a year ago first assistant engineer of the highway division of the Massachusetts Department of Public Works, died recently after a lingering illness. Mr. Lovis was a graduate of the Massachusetts Institute of Technology and subsequently worked on the relocation of the old Vermont & Massachusetts R.R., which is now the new Fitchburg Division of the Boston & Maine R.R. He entered the service of the State of Massachusetts in 1895.

COLONEL CLEMENT A. F. FLAGLER, commanding officer of the Eastern Division of the Corps of Engineers, U. S. A., with headquarters in Baltimore, died May 7 at Johns Hopkins Hospital, Baltimore, following an illness of three weeks. Col. Flagler was 54 years old. He was a native of Georgia and was the son of Gen. D. W. Flagler, Chief of Ordnance. He was a graduate of Griswold College, the United States Military Academy, the Engineering School of Application and the Army War College. In 1919 he was commandant of the Engineer School at Camp Humphreys. During the early part of the war he went abroad with the American forces. He was a member of the Board of Engineers for Rivers and Harbors. During the World War Col. Flagler, with rank of brigadier-general, commanded the Fifth Artillery Brigade and was Chief of Artillery for the Third Army Corps during the Meuse-Argonne offensive. He was promoted to be major general, commanding the 42d Division, and during the occupation of Germany was military governor of the Ahrweiler district.

EQUIPMENT AND MATERIALS

Copper Shingles

Copper shingles and other roofing units, such as ridge and valley flashings, verges and eaves starters, are being produced by the Anaconda Copper Mining Co., New York, at reasonable



costs by using a special thinly rolled copper made up in units which permit economical installation. By making the shingle with thickened butts and in moderate sizes the appearance of the roof is improved. Several colors are also available. It is announced that by manufacturing in standard sizes, simplified packing and transportation and provision for rapid application the cost of copper roofing is brought down to a level where it is available for ordinary residence construction.

Business Side of Construction

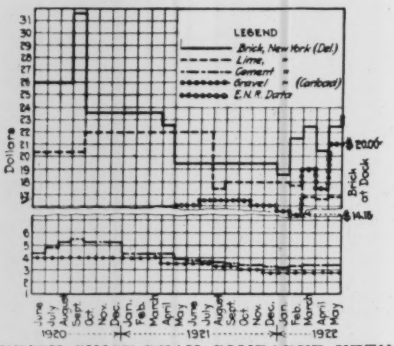
Facts and Events that Affect Cost and Volume

Brick Prices are Climbing Toward 1920 Peak

Price at New York Dock and on the Job—Record Gain of $5 in Last Five Months

That brick prices are climbing to peak quotations of 1920 is evidenced in this week's review of the brick market conditions and a general survey of *Engineering News-Record's* prices for the last three years. Curtailed production or natural shortage, with unprecedented demand, form the basis for the price boosting of recent weeks. The quotation of $20 for Hudson River common brick, wholesale, stands out in interesting comparison with the quotation of $15 per 1,000, alongside dock, New York, which prevailed throughout the last eight months of 1921.

Stiffened tendency of building materials prices has taken the brick market practically out of control, it is pointed out. With the total amount of brick burned available throughout the whole country on Apr. 1, at 60,000,000 less than the number on hand on Mar. 1,



BRICK SINCE PEAK COMPARED WITH OTHER MATERIALS

and orders increasing on the books in one month from 167,000,000 to 197,000,000, the present unprecedented construction program forces an embarrassing situation. This shortage, thus far, has been acutely felt in Boston and New York, while other districts are only beginning to feel the pinch.

Spurred on by the growing demand for the product of their labors, the brick makers went on strike in two of the most vital centers of production. The Raritan district strike, however, was quickly adjusted by a 10 per cent advance in wages. In the Haverstraw center of the Hudson River district, where 1,400 brick makers are now on strike, conditions are unfavorable. Workers in this district demand an increase of $1, making the average pay $4.50 as against the present wage of $3.50.

Manufacturers state that the shortage is caused by labor troubles but the question arises as to whether the condition is naturally or artificially produced. Samuel Untermyer, chief counsel to the Lockwood Joint Legislative Housing Committee, believes that the dealers are not responsible for the brick shortage but charges the responsibility to the manufacturers. He has stated that the yards are not being operated to any thing like their capacity and that work was not started sufficiently early to accumulate adequate stocks before the yards closed for the winter months. Accordingly, the Lockwood Committee has requested Congress to provide emergency tariff regulations permitting the importation of foreign building materials into the United States. Imported common brick, for instance, under the proposed provision, could be sold at $14 per 1,000 alongside dock, New York. The present tariff is 10 per cent ad valorem.

Brick prices reached the highest point in Sept., 1920, quotations then being as high as $30.75 per 1,000 delivered on the job in New York City. Prices then dropped to $22.70, then to $21.70 during the second quarter of 1921, finally reaching a fairly stable basis of $18.40, in effect from May to Dec., 1921. Early in Jan., 1922, prices dropped to $17.40, rising again to $20.40 in Feb. and $21.40 in Mar., 1922. Apr. quotations dropped to $19.40 but have since risen with the increased demand to the present basis of $23.40 per 1,000 delivered. A margin of $3.40, comprising the cost of handling, haulage ($1.40@$1.50) and 10 per cent, realized by the dealers, leaves a price of $20 wholesale, alongside dock.

Dealers claim that profiteering cannot be justly charged to them, having added the $3.40 to the wholesale price they allow the blame to rest where it may.

Financial Paragraphs

Cost of money last week showed call loans at 3½@4½; time loans at 4½. The previous week call was 3½@5; time at 4½@4½.

Foreign trade figures for exports in March were $332,000,000 compared with $386,680,346 in 1921; imports $258,000,000 compared with 251,969,241 in 1921.

Gross railroad earnings for the first week in May for nine roads were $7,283,537 compared to $7,119,471 for the corresponding period of 1921.

Cement Up in the East

Higher-prices of coal has caused a general advance of cement in the East—20c. in the Lehigh Valley district, and 10c. per bbl. in the Hudson district. The new quotations to dealers (10c. more to contractors) are: $1.80 per bbl., without bags, in the Valley; $1.90 at Hudson, N. Y. Price alongside dock, New York, to dealers is $2.50 including bags, $2.10 net. Coal which cost $2 per ton at the mines, on contract, costs about $4 spot at present, and about 200 lb. of coal are required to produce a barrel of cement.

Week's Failures Fewer

Business failures were fewer this week as compared with that of last week, according to Dun's statistics. This week there were 408 insolvencies reported, while last week there were 491, and during the corresponding week in 1921, 333 defaults were shown.

The country's business mortality, as measured by Dun's insolvency statistics continues much above the average, but there has been an irregular reduction in number of failures during recent months. The April total of 2,167 is about 12 per cent below that of March and discloses a decrease of fully 20 per cent from the 2,723 defaults of January of this year, which was the highest point reached since the beginning of 1915.

Freight Loadings Gained 44,198 Cars in Week

A total of 758,286 cars of revenue freight were loaded during the week ended Saturday, April 29, showing a gain of 44,198 cars over the previous week, according to statistics compiled by the Car Service Division of the American Railway Association. Compared with the corresponding week in 1921, it is an increase of 43,590 cars but a decrease of 22,509 cars compared with the same week in 1920.

Although this is the fourth week of the coal miners' strike, the loading of all commodities has increased. Forest products increased 3,253 cars, and ore, 4,283 cars, the largest gains made in these commodities for some weeks past.

Serviceable surplus freight cars for the week ended Apr. 30 total 371,538, a decrease of 226 from the previous week. Classified, 94,653 were box cars, and 235,077 coal cars, balance miscellaneous.

SURPLUS AND SHORTAGE STATEMENT—APRIL 23 TO 30, 1922

Districts	Flat Cars Surplus	Flat Cars Shortage	All Box Cars Surplus	All Box Cars Shortage	All Coal Cars Surplus	All Coal Cars Shortage	Total All Cars Surplus	Total All Cars Shortage
Eastern	1,343	15	16,258	221	87,602	...	110,188	236
Allegheny	497	...	13,262	...	104,206	...	121,702	0
Pocahontas	157	54	814	91	4,415	...	6,353	0
Southern	2,513	15	9,122	...	7,945	324	23,699	474
North Western	873	...	22,651	55	2,813	...	31,846	15
Central Western	1,085	...	23,234	2	24,605	50	61,908	115
South Western	609	...	9,312	...	3,451	...	15,842	2
Total	7,077	84	94,653	369	235,077	374	371,538	842
Canadian Roads	2,085	...	28,035	...	1,710	...	38,665	0
Grand total	9,162	84	122,688	369	236,787	374	410,203	842
April 23, 1922	10,568	78	123,541	161	231,722	74	407,834	343

Steel Optimism by Gary

"Employment is always an indication of the business pulse of a nation," says Judge Elbert H. Gary, Chairman of the United States Steel Corp., interviewed by a New York newspaper. "Already we are beginning to feel a pinch in labor supply. This is essentially true of unskilled labor. . . . Iron and steel, it is said, are the barometers of the nation's business. Today the outlook in this industry is better than it has been since the early part of 1921 when the business boom following upon the close of the war collapsed. That boom, as is now appreciated, was unhealthy, built of the stuff that the war fever nurtured. The year 1922, it is my belief, will be a very great improvement on 1921 and very greatly superior, from the business point of view, to 1920. Today manufacturers of iron and steel report that they are selling more than double the quantity that they sold six months ago."

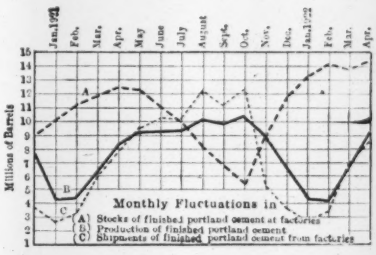
Building Construction on Pacific Coast at High-Water Mark

In the seven Pacific States constituting the Twelfth Federal Reserve District the value of building for which permits were issued in the month of March, 1922, was the largest ever recorded in an equal period, according to a report by John Perrin, chairman of the board, Federal Reserve Bank, San Francisco. March permits represented a value of $27,432,286, or 17 per cent more than October, 1921, the previous record month, and 47 per cent more than March, 1921.

In the first four months of this year San Francisco building construction reached a total value of $15,642,940. The city's total for the entire twelve months preceding was $22,244,672.

Cement Production Gained in April

Cement produced in April was 9,243,000 bbl., 582,000 bbl. heavier than in April, 1921. The first quarter of 1922 was only 14,000 bbl. higher than the



corresponding period of 1921. The chart shows the trend of production, shipments and stocks.

Bank Clearings Gain

In common with some other statistical barometers, records of bank clearings reflect the improvement in general business. Recent monthly exhibits have disclosed a widening margin of increase over last year's clearings, and the April gain at 110 cities in the United States is 12.4 per cent, according to Dun's statistics.

Heaviest Car Orders in Years

Against a possible car shortage, it is recorded that better than 31,000 freight cars were ordered during the month of April which marks the heaviest buying period of this character in years. Orders placed in April increases the total number of cars awarded this year to date to over 70,000.

Largest April Public Bond Sales Since 1893

Long-term municipal bonds sold during April aggregated $130,920,098, an amount in excess of any corresponding April total in the last thirty years; according to records of the *Commercial and Financial Chronicle*. March totals reached $117,072,378; sales for April, 1921, amounted to $86,691,392. The largest previous April figure was $103,224,074, in 1914, while the lowest recorded was $3,570,963 for April, 1898.

The largest issue for April, 1922, was $45,000,000 New York City 4¼s gold corporate stock, sold to Speyer & Co. for 102.766, or a basis of 4.119 per cent. Among the most important issues in April were: North Carolina, $6,000,000 4½s at 100.10, a basis of about 4.49; Illinois, $6,000,000 4s at 98.875, a basis of 4.11; Ohio, $5,000,000 4¾s at 101.76601, a basis of about 4.14; Newark, N. J., $3,503,000 4½s, or a basis of 4.25 per cent; Providence, R. I., $2,000,000 4s at 98.97, a basis of 4.05; St. Louis County, Minn., $1,500,000 5s at 103.2279, a basis of 4.55; South Dakota, $1,000,000 4¾s at 101, a basis of about 4.63 per cent.

Short-term securities issued in April aggregated $37,965,000. A total of 471 municipalities issued permanent bonds during April, 1922, as against 463 in March, 1922, and 539 for April, 1921. Although the number of municipalities emitting permanent bond issues was over 12 per cent fewer, the total value of sales was 51 per cent higher in April, 1922, than for the corresponding month in 1921.

Of our list of thirty-seven representative issues thirty sold above par and three at par, the yield ranging from 4.08 to 5.97. The rates varied from 4 to 6 per cent. The eight 6s were in the South, Middle West and West.

REPRESENTATIVE BOND SALES OF APRIL AND MAY, 1922

State	Purpose	Amount	Maturity	Rate Per Cent	Basis	Sold For	Dated	Purchased By
North Carolina	Highway	$6,000,000	.....	4½	4.49	$100.10	Apr., 1922	Syndicate of N. Y. and N. C. bankers
Illinois	Highway	6,000,000	.....	4	4.11	98.875	Apr., 1922	Hallgarten & Co.
South Dakota	Highway	1,000,000	.....	4¾	4.63	101.00	Apr., 1922	Continental and Commercial Trust and Savings Bank, Chicago, Ill.
County								
Bradford, Fla.	Roads	550,000	1923–52	6	....	99.01	May 2, 1922	Blanchett, Thornburgh & Vandersall, Cincinnati, Ohio
Buchanan, Mo.	Roads	600,000	1931–36	5	4.44	105.01	June 1, 1922	Empire Trust Co., St. Joseph, Mo., and others
Carlton, Minn.	Courthouse	120,000	....	4¾	....	101.00	....	Gates, White & Co.; First Nat. Bank of Duluth
Curry, Ore.	Roads	60,000	1936	5½	....	100.41	Jan. 1, 1922	Ladd & Tilton Bank, Portland, Ore.
Dona Ana, N. M.	Road and bridge	60,000	1952	5	....	96.66	May 1, 1922	Bankers Trust Co., Denver, Col.
Hamilton, Ohio	Hospital	200,000	1924–43	6	....	100.00	Apr. 1, 1922	Sinking Fund Trustees
Holmes, Ohio	Road imp't	41,500	1923–28	5½	5.13	101.32	Apr. 1, 1922	W. L. Slayton & Co.
Jackson, Mich.	Road	300,000	1923–36	5	....	100.00	May 1, 1922	Jackson City Bank, Jackson, Mich.
La Fourche Parish Road Dist. No. 1, La.	Road	50,000	1940	6	5.625	102.70	Sept. 15, 1920	Hibernia Securities Co., New Orleans
Liberty, Tex.	Road	1,309,000	....	5½	....	102.947	....	Guaranty Title & Trust Co., Cincinnati
Newberry, S. C.	Highway	200,000	1923–62	5	4.90	102.33	May 1, 1922	Stacy & Braun, Toledo, Ohio
Oak Park, Park Dist., Cook Co., Ill.	Park	50,000	1937–39	5	4.25	108.41	May 1, 1921	Oak Park Trust & Savings Bank
Smith's Prairie Highway Dist., Elmore Co., Ida.	Highway	25,000	1942	6	....	100.00	Jan. 1, 1922	First Nat. Bank of Mountain Home, Ida.
Traverse, Minn.	Ditch	18,000	1933–42	4½	....	100.20	May 1, 1922	Minnesota Loan & Trust Co., Minneapolis
	Road and bridge	3,524	1937					
Washington, Pa.	Road imp't	500,000	1932–45	4½	4.08	105.027	May 1, 1922	Guaranty Co. of New York
Municipality								
Alexandria, Minn.	Electric lights	30,000	....	5	....	102.80	Apr. 1, 1922	Minneapolis Trust Co., Minneapolis, Minn.
Avalon, N. J.	Boardwalk	11,000	1923–33	6	5.91	100.45	Apr. 1, 1922	Security Trust Co., Camden, N. J.
Baltimore, Md.	Improvements	8,332,000	1930–52	5	4.31	107.805	May 1, 1922	Alex. Brown & Sons and others, N. Y. C.
Beloit, Wis.	Street imp't	50,000	1923–38	4½	4.58	102.04	May 15, 1922	Beloit State Bank, Beloit, Wis.
Childress, Tex.	Water	310,000	....	5½	....	101.00	....	W. A. Myrick & Co., Dallas, Tex.
Clarendon, Tex.	Water	75,000	1962	6	....	104.87	May 2, 1922	Dunn & Carr, Houston, Tex.
Des Moines, Ia.	Waterworks	250,000	1933–42	5	4.37	101.50	Apr. 1, 1922	
Elkin, N. C.	Public imp't	160,000	1924–62	6	5.97	100.37	Apr. 1, 1922	Clairborne, Royall & Co., Goldboro, N. C.
Grand Is., Neb.	Sewer	200,000	1927–42	5	....	97.76	May 3, 1922	Omaha Trust Co., Omaha, Neb.
	Drainage	100,000						
Hammond, Ind.	Waterworks	250,000	1922–51	6	4.70	115.34	Oct. 15, 1921	R. L. Day & Co., Boston, Mass.
Honolulu, H. T.	Waterworks	250,000	1952	5	....	107.14	Apr. 15, 1922	Otis & Co. and The 5th Nat. Bank of Cincinnati
Johnstown, Pa.	Park	350,000	1952	4½	....	104.75	.....	J. H. Holmes & Co., Pittsburgh
	Bridge	38,000	1952	4½	....	100.00	.....	City of Johnstown, Sinking Fund
Larchmont, N. Y.	Road	39,000	1927–52	4.35	4.34	100.00048	June 1, 1922	Geo. B. Gibbons & Co., New York City
Leaksville, N. C.	Water and sewer	215,000	1925–62	5½	5.48	100.14	Feb. 1, 1922	Stacy & Braun, Toledo, Ohio
McDonald, Pa.	Municipal Bldg.	70,000	1923–52	4½	4.34	105.89	May 1, 1922	J. H. Holmes & Co., Pittsburgh
Mount Vernon, N. Y.	Drainage	150,000	1923–42	4½	4.22	100.35	May 1, 1922	Lamport, Barker & Jennings, N. Y. C.
	Paving	100,000	1923–32					
Northampton, Mass.	Highway	60,000	1923–32	4½	4.21	101.43	May 1, 1922	E. H. Rollins & Sons, Boston, Mass.
Orangeburg, S. C.	Street imp't	250,000	1925–44	5	4.99	100.02	Mar. 1, 1922	Trust Co. of Georgia, Atlanta, Ga.
Paterson, N. J.	School	785,000	1923–57	4½	4.27	102.54	Apr. 1, 1922	Lamport, Barker & Jennings, N. Y. C.

Steel Merger Draws Senate Demand for Inquiry

Merger of the two largest independent steel producers in the United States is to be effected through the purchase by the Bethlehem Steel Corporation of the Lackawanna Steel Co. E. G. Grace, president of the Bethlehem Corporation, states that the acquisition of the Lackawanna Co. will give his company an entrance to the markets of New England and Eastern states and will otherwise supplement its manufacturing and marketing facilities.

The combined companies are reported to have an ingot capacity of about 5,000,000 tons of which the Lackawanna contributes 1,800,000 tons and the Bethlehem 3,200,000 tons. The United States Steel Corporation has a capacity of about 22,000,000 tons. On motion of Senator LaFollette of Wisconsin, the Senate has called upon the Department of Justice and the Federal Trade Commission to investigate the transaction and to inform the Senate as to what action has been taken "to protect the public interests." Information is requested also as to whether proceedings under the Sherman and Clayton acts may be desirable. The Lockwood Committee is to investigate.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of May 4; the next, on June 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$2.58	+$3.50	$4.00	$2.48	$2.76	$3.50	$3.10	$3.60	$3.75
Structural rivets, 100 lb.	3.50	+4.25	5.50	3.10	3.90	4.45	4.50	3.75	6.50
Reinforcing bars, ¾ in. and larger, 100 lb.	2.48	+3.50	3.50	2.38	2.66	+3.52½	2.55	3.60	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9-5%	44%	56.1%	53%	30.00
Cast-iron pipe, 6 in. and over, ton	46.80@47.80	+48.00	48.30	44.10	+48.50	55.00	51.00	52.00	50.00
Concreting Material:									
Cement without bags, bbl.	+2.50@2.60	2.39	2.25	1.97	2.24	2.90	+2.83	2.94	2.48
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	1.80	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd.	1.00	1.15	2.25	1.80	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	48.00	36.00	34.50	40.00	39.00	36.75	26.00	20.00	47.00
Lime, finishing, hydrated, ton	15.80@16.80	18.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.18	1.25	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000.	+23.40	9.00	11.15	11.00	15.00	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.0795	.115	.0821	.0752	.08	....	.12	.09
Hollow partition tile 4x12x12, block	.11120	.072	.115	.0657	....	.08	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.95	+1.05	1.09	+1.04	1.06	+1.18	+1.04	.86	.97
Common Labor:									
Common labor, union, hour.	.75	.35	.....	.80	.....	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour.	.44@.60	.20	.25	.72½	.40@.50	.35@.50	.47½@.50	.....	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $1.75 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump line per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed store quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks.

Montreal quotes on fir instead of pine. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.62 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

All price changes upward; no declines. Steel shapes quoted in Atlanta at $3.50 as against $3.35 per 100 lb. at warehouse. Rivets also up 35c. and reinforcing bars 25c. per 100 lb. Bars quoted in Denver at $3.52½ as compared with $3.42½ per 100 lb., last week. Another week of brisk buying in the iron market has resulted in advanced prices of cast-iron pipe. Atlanta quotes $48 as against $42 and Minneapolis $48.50 as compared with $48 per ton, one week ago.

Cement quoted at $2.60@$2.85 per bbl., without bags, delivered on job, New York, as against $2.60, flat, last week. San Francisco warehouses quote $2.83, advanced from $2.73 per bbl., without bags.

Common brick quoted at $23.40 delivered; $20 per 1,000 wholesale, alongside dock, New York. Brick prices stood at $18@$20 per 1,000 wholesale, one week ago, but the quotation of $18 has entirely disappeared from the market. Turn to page 848 for a wider explanation of the New York brick situation.

Raw linseed oil up 3c. in San Francisco; 5c. in Chicago; 6c. in Denver and 9c. per gal., in 5 bbl lots, in Atlanta.

A total of 355 mills reporting to the National Lumber Manufacturers' Association for the week ending May 6, show 198,258,169 ft. cut; 208,703,877 ft. shipped and orders for 247,000,175 ft. b.m. Production stands at 7½ per cent and shipments at 3 per cent below while orders reach 14½ per cent above normal.